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**TEETH,
DIET AND HEALTH**

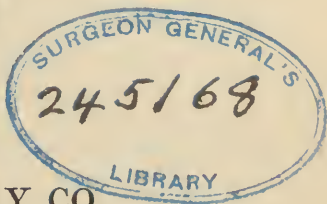
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TEETH, DIET AND HEALTH

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ILLUSTRATED



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PREFACE

Does the public know that the most important dental diseases, some of which undermine the health of virtually all civilized people, are, to a large extent, preventable? Evidently not, because the large number of dentists who are fighting the progress of ever-increasing dental diseases and repairing the ever-decaying teeth are unable to cope with the problem.

To bring about a change in prevailing conditions it is necessary to have an understanding of the causes, symptoms, and effects of the various dental diseases and of their constant menace to the general health.

Preventive dentistry has made great advances, and methods have been developed to check dental diseases to a great extent. Patients who coöperate with the dentist's efforts by proper care at home can demonstrate the truth of the slogan, "A clean tooth never decays."

The habits of diet in different communities are largely based on custom, rather than on scientific

knowledge of the needs of the body. The modern diet has a destructive influence on the teeth, with far-reaching consequences, which are not yet fully understood by the general public. The recent discoveries of certain constituents, called vitamins, of natural foods and their relation to the proper development and quality of the teeth of the growing child are topics which should become the common knowledge of every father and mother throughout the world, and of all who have to do with the education and care of children. The application of this knowledge involves no cost and, therefore, is within the reach of every one.

That there is a definite demand for instruction along these lines was represented to me by readers of my previous works, who suggested that a non-technical book, dealing with dental diseases and emphasizing the importance of diet, would do a public service.

To meet this demand, I present this book, written in popular language, with the hope that it may bring before the public matters of vital concern.

KURT H. THOMA

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TEETH, DIET, AND HEALTH

Teeth, Diet. and Health

CHAPTER I

VALUE OF THE TEETH IN HEALTH AND DISEASE

“And teeth of pearl, and lips that vie with coral.”

Symmetrical, sound, and healthy teeth beautify the face. It is of no consequence whether they are pearly white, or of a slightly bluish or greenish hue; the color depends principally on the complexion of the individual. In the brunette types the teeth are dark; in the blond they are light. The important part is that they be well kept and well preserved, indicating wholesomeness, cultivation, and refinement. No matter with what fine qualities a person may be endowed, there are frequent occasions when he is judged entirely by first impressions. Broken-down teeth, in irregular position, such as are frequently caused by pyorrhea, and the loss of teeth which are not replaced by artificial dentures, destroy the facial harmony. Lines appear in the face, the lower eyelids droop, the cheeks and corners of the mouth

sag, producing an expression of dejection and lack of spirit. Such dental infirmities may become a serious hindrance to our progress in life and react to our disadvantage in all social relations. The sweetheart, wife, friend; the business or professional man and the employee—no one can afford to neglect his teeth. They are an important asset to life's success!

Recognizing that the teeth play an important part in their appearance, some savage tribes are willing to submit to great suffering to mutilate the teeth, with the idea of beautifying themselves. In French Indo-China, for example, it is the custom to dye the teeth black, because there is an intense dislike for the possession of white teeth, like those of dogs. Certain African tribes file their teeth triangular to simulate ferociousness, while others use angular patterns, or notch the sides of the incisors, as a distinctive mark (Figure 1). J. J. Mann, in "Round the World in a Motor Car," makes the following statement about the Hindus: "Natives, clad in rags, or a rag—dirty beyond description, brush their teeth every day and never twice with the same tooth-brush. Their religion teaches them to cut a twig from a special tree, which has an astringent sap, and to



FIG. 1. A CHICHIRI BOY

This type of tooth chipping is common to many tribes

Courtesy of Professor Frederick Starr, from his book on "Congo Natives," Chicago, 1912

use one of these with plenty of water every day. As the operation takes place on the sidewalk, or where the sidewalk ought to be, you can see them daily as you pass, engaged in this interesting occupation. Their teeth are as white as ivory." The fact that the Hindu is proud of a good set of teeth and takes his religious teachings to heart is further illustrated by Mann, who says, "If you want to insult him, you must say his mouth is dirty, and that will fill his cup with bitterness to the brim."

The Teeth in Emotional Expression

The psychoanalyst is able to form an opinion of the mental attitude of a speaker from an intelligent study of his facial expressions. In business and social life we all form opinions, not necessarily intelligent, from our daily personal contacts. Certain gestures and movements of the muscles of the face give the initiated a great deal of information.

If a person is well disposed and friendly toward us, he generally presents the appearance which we associate with smiling and laughter. In this emotion the lower lip is somewhat raised, exposing the upper front teeth. Who can resist

the smile made radiant by a row of beautiful teeth, even though the face is otherwise unprepossessing; and what one of us has not been charmed by the spontaneous laughter of a child, who, with head thrown back, discloses its pearly array?

Not only in the pleasant emotions do the teeth play their part in facial expressions, but also in rage when the lips are retracted and the corners are raised and drawn back, revealing the cuspids (canine teeth). This may be a habit inherited from primeval semi-human ancestors, who fought with tooth and nail. It is still the common expression of the angry or defensive animal. Its various modifications warn us of a hostile, antagonistic, and unfriendly attitude.

Sneering, the indication of contempt, is usually accompanied by a drawing back of the corners of the mouth and a lifting of the outer part of the upper lip. This, however, occurs on only one side of the face. A sardonic smile is effected in the same way.

The orator, the public speaker, and the singer find the teeth of great importance in their professions. A wide dental arch and well formed vault are great factors in voice production. Without teeth, precise and clear enunciation

would be impossible, and with the loss of certain teeth articulation is greatly impaired.

Mastication

The most important of the dental functions, however, is that of mastication, which is the first step in digestion. Unless the food is properly prepared in the mouth it is not only seldom used to the greatest advantage but causes disturbances in the digestive tract. The use of the teeth includes the cutting action brought into play when biting off a piece of food, as well as the grinding movements of the back teeth (bicuspid and molars). It permits mixture with the saliva and prepares the food for gastric digestion.

Value of Healthy and Diseased Teeth

The healthy or diseased condition of the teeth has, so far, not been taken into consideration. While the possession and preservation of good teeth should be a constant source of joy, the importance of their functions, which have just been described, should not be allowed to influence us when the teeth are diseased. The fact that there is no pain or discomfort does not imply freedom from disease. Often the unsuspecting individual is not aware of the menace existing in his jaws

and the danger of their infection undermining his general health and causing the gravest chronic diseases. Such conditions are much more common than is generally supposed. It is a rare occurrence nowadays to find any one who has not fallen a prey to one or another of their various manifestations. Indeed, the majority of middle-aged people find their dental apparatus sadly depleted. Notwithstanding the fact that our parents may have seen to it that we had proper dental care and attention, and in the face of the efforts of the family dentist and the time and expense involved, many teeth have become infected. It is, therefore, easy to understand why so many people sum up their dental experience in the statement that teeth are an affliction from their eruption to their extraction.

Healthy, normal teeth are a priceless possession, but those which, through pulp removal, have lost their blood-supply become objects of suspicion. If, in addition, infection has occurred at the apex of the root, they become a questionable blessing, while in cases where this infection has become also a focus of ill health—a source of disease in other parts of the body—the tooth becomes a menace and its possession a curse.

Diseased Teeth a Continual Expense and a Sign of Neglect

Neglected and diseased teeth are not only the cause of continual discomfort, ill health, and expense but are a humiliating exhibit of bodily neglect. Any one who is careless of a matter so intimately connected with his own interests is very liable to give the impression of negligence in other matters. The beholder cannot fail to associate unhealthy-looking teeth with a general carelessness in the conduct of business and social affairs.

The preservation of the teeth, as we have seen, is intimately connected with those ambitions dearest to us all—health and success. It is the duty of all parents to acquaint themselves with the results of neglect of the teeth and the means which influence the development of normal jaws and strong, healthy teeth. The prevention of diseases of the teeth not only decreases the dentist's bill but reduces the family living expenses and, in consequence, is as great a boon to the poor as to the rich. How this can be accomplished is taken up in the chapters on prevention and diet. Here it is sufficient to point out that it is the

privilege and obligation of every father and mother to use their influence in applying the simpler principles of preventive medicine and dentistry for the benefit of their children.

CHAPTER II

SEVEN THOUSAND YEARS OF DENTAL DISEASE

“Records that defy the tooth of time.”

The conviction that most dental diseases are preventable was reached by the writer during his investigations in anthropology. Examination of the teeth and jaws of ancient skeletons, together with a knowledge of the dental diseases of antiquity and a study of the conditions existing among isolated races to-day, give important information as to the possible causes of dental diseases, especially when considered in relation to their habits of living and diet.

The Ancient Egyptians

From papyri dating back as far as fifteen hundred years before Christ, and from the writings of the Greek historian Herodotus (born 484 B. C.), we can learn much of the life and customs of the ancient Egyptians. Herodotus journeyed to the shores of the Nile to learn the sacred mysteries and sciences of this nation of advanced learning and comparatively high civilization. He found

that surgery and medicine were divided into distinct professions and that each of these branches had developed specialists in certain lines. These specialists were required to study the precepts laid down from the experience of their predecessors before being allowed to practise. There were surgico-physicians who treated diseases of the eyes, the ears, the digestive tract, and the teeth. Dentistry had, therefore, already been developed into a specialty. In general it was believed that most ills were referable to the digestive process, and the treatment usually consisted of small doses of medicine and other simple means of relieving the system. Great stress was laid upon the prevention of illness by abstinence and attention to regimen and diet. Unfortunately, we have no records of the remedies and surgical proceeding used for dental diseases.

Specimen Showing Egyptian Dental Surgery

While examining, in the Peabody Museum of Harvard University, a group of Egyptian mummies, which had been unearthed in Giza by Professor S. A. Reisner from a tomb of the Old Empire period (approximately 2500-2200 B. C.), the writer had the good fortune to discover evidence of a surgical operation which had been per-

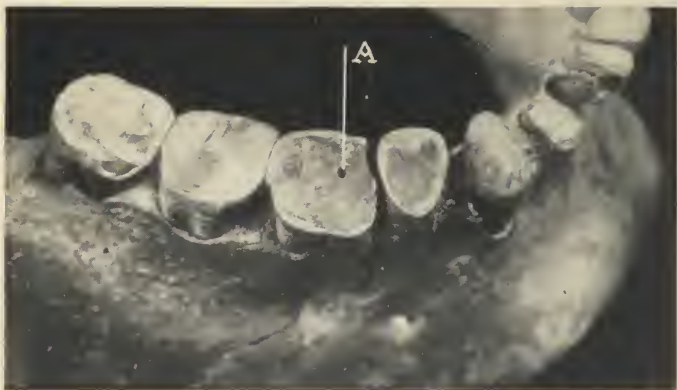


FIG. 2. LOWER JAW OF AN EGYPTIAN MUMMY FROM THE OLD EMPIRE PERIOD, SHOWING EVIDENCE OF AN OPERATION DISCOVERED BY THE WRITER

Observe how all the teeth are worn down on the grinding surfaces. On the first molar the pulp (A) became exposed

Specimen photographed through courtesy of Professor Frederick Ward Putnam and Dr. E. A. Hooton, Peabody Museum, Harvard University



FIG. 3. SAME SPECIMEN

The two holes (B and C) in the side of the jaw below the first molar indicate a surgical procedure practiced by the ancient Egyptians for the purpose of establishing an outlet for the pus

formed. Attention was first attracted by a very small circular hole in the masticating surface of the first molar in one of the jaws. The surface of the tooth had apparently been worn down to such an extent that the pulp was exposed to infection (Figure 2). This condition was common among the early Egyptians, as will be seen later, and it generally resulted in what is now called an alveolar abscess—an infection in the center of the bone around the root of a tooth. That such an infection had occurred in this case was proved by means of an X-ray picture, which showed that around the roots of the tooth there was a dark area, such as we know to be associated with loss of bone because of an abscess. The interesting feature of this specimen, however, was two holes in the side of the jaw. These are shown in Figure 3.

Closer examination revealed the fact that one of these holes led between the two roots of the molar, the other between the molar and bicuspid. Their regularity of outline and identical size indicated that they were artificially produced to permit drainage of pus from the abscess inside the bone. When I showed the specimen to Dr. Hooton of the Peabody Museum he investigated on his own account. The right side of the jaw

being fractured in such a way as to expose the infected area, he found by taking it apart that the two holes led through sound tissue into the abscess cavity. This confirmed my own conclusions, that oral surgical procedures were practised nearly three thousand years ago.

Egyptian Teeth Show Signs of Wear

Further examination of these mummies brought out some very interesting facts. The specimens were from the predynastic period and the Old and Middle empires, ranging from 4800–2000 B. C. The most apparent condition was the tremendous wear (attrition) on the masticating surfaces of all the teeth. Unworn cusps were but rarely found; the masticating surfaces were worn so smooth that often the dentine was exposed; and facets, such as we find in the front teeth of horses, were visible. The temporary teeth of the children showed the same results of wear.

The Diet of the Ancient Egyptians

“What did the ancient Egyptians live on?” was my first thought, when I realized that all their teeth showed evidence of this same attrition. Sir J. Gardner Wilkinson, in his writings,

states that the early Egyptians were very moderate eaters. While they took pride in serving a profusion of food for the entertainment of guests, their diet, in private life, was very simple. It consisted mainly of vegetables, fruits, and esculent roots, some of which were eaten in the crude state and others were roasted or boiled. Lentils, milk, cheese, and much fruit appear to have been the important articles of the laborer's diet. Meat was consumed by the more well-to-do classes, but was plainly cooked. Herodotus writes that the builders of the pyramids lived mainly on onions, garlic, and lentils. The rich ate pastries, sweetened with figs, dates, and honey, but sugar and sugar-cane are not mentioned and apparently were unknown. This simplicity of diet began to give way about 1600 B. C., and in later periods the Egyptians became somewhat addicted to excesses, although never to the extent of the Roman indulgences.

Bread was an important food in ancient Egypt and was used by both the rich and the poor. For those who could afford it the bread was made of wheat and corn, while the poor used barley and sorghum flour. Adolf Erman, in "Life in Egypt," says that bread was largely consumed in all periods of Egyptian history. In the Middle

and New empires they had great mortars in which corn was pounded with pestles. Finer flour was made by rubbing grain between two stones, and this, after being kneaded into dough, was baked in flat round cakes.

The coarse food eaten by the ancient Egyptians might at first be thought to have caused the wear on their teeth. It will be found, however, if the condition is studied more carefully, that the method employed to prepare the grain and corn allowed a certain amount of grit to get mixed with the flour, and this is supposed to have been the main cause of the condition.

Some Other Dental Diseases

Pyorrhea was not present, and real dental caries was seen in only two teeth of the many jaws in the Peabody collection. It is curious that a race so free from this disease of modern civilization should nevertheless have fallen prey to the same evil consequences that to-day follow tooth decay. This occurred in the following manner: The teeth kept wearing down until finally the pulp became exposed. An infection of the pulp then set in, similar to that which we get from dental caries. In this stage the tooth frequently began to decay from the inside and crumble down

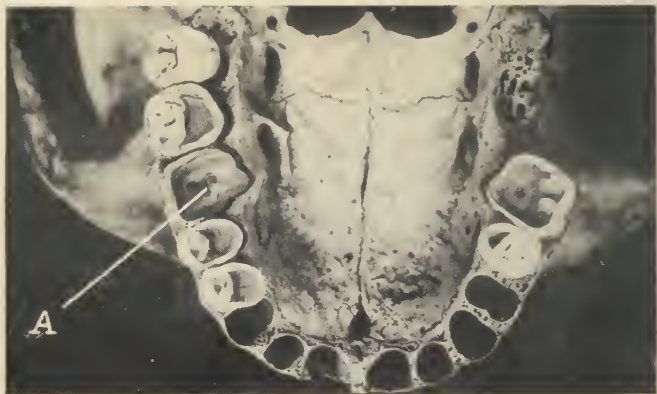


FIG. 4. SPECIMEN FROM SAME COLLECTION AS FIGS. 2 AND 3, SHOWING THE TEETH OF AN UPPER JAW FROM A PRE-DYNASTIC EGYPTIAN SKULL

Note the facets on the masticating surfaces of the teeth. The exposed pulp (A) caused infection



FIG. 5. SAME SPECIMEN SEEN FROM THE SIDE, SHOWING BONE DESTRUCTION

B indicates the abscess cavity which had formed in the bone at the root of the tooth

almost even with the gum, a condition which leads to the mistaken idea that it was due to dental caries. From the pulp the infection spread through the opening at the root-end into the surrounding bone, causing tooth abscesses similar to those which are found to-day on so-called "dead" or pulpless teeth. That these bone infections of dental origin were very frequent is quite evident, as they are found in almost every specimen. The one in Figure 4 shows an open pulp chamber in an upper first molar. This was due to wearing down of the masticating surface. The opening is marked A and can be seen easily in the picture. In Figure 5, a side view of the same specimen, the abscess cavity (B) is visible around the root of the tooth. In connection with these dental infections it is interesting to note that "rheumatism" was also quite common.

The Ancient Greeks and Romans

Hippocrates, who was one of the most accurate observers of his time (born 460 B. C.), gives in his writings some idea of the status of the teeth of the ancient Greeks. A lineal descendant of Æsculapius and famous for the axiom, "Diseases must be combated in their origin," he describes diseases of the teeth and their treatment, both

manual operations and dentifrices. Two types of necrosis are distinguished by him, dislocated jaws seem to have been common, and a disease associated with flattening of the ridge of the jaw and sloughing of the gums is without doubt our modern pyorrhea.

Both dental caries and pyorrhea were rampant among the Romans of the Christian era. In the records of Celsus, a celebrated physician of Rome, born 30 B. C., we find that he advised extraction of teeth and filling with gold, while for loose teeth (pyorrhea) he prescribed scraping, fixing with gold wire, and scarifying the gums.

Roman Feasts

“The sad workings of a superior civilization, is the cause of the decadence of our health,” complained Celsus, and it is small wonder that diseases of the teeth were extremely common in a people so given to feasting. While up to 188 B. C. their food was prepared with great simplicity, new methods of cooking began to be introduced in the year the Roman army returned from Asia Minor. In the two centuries which followed, cooking gradually became more and more elaborate; every establishment of any standing employed a number of cooks, each of whom special-

ized in some phase of food preparation—pastry-cooks, meat-cooks, etc. Banquets in the time of Nero, who reigned from 54 to 68 B. C., were extremely sumptuous. It is said that the emperor would sometimes sit down to a table at noon and not leave till midnight, a profusion of delicacies being served throughout the whole period. Sometimes the cookery took a whimsical turn, as, for example, when a pig would be served roasted on one side and boiled on the other.

Aristotle, who followed Hippocrates, was the first to state that he thought decay of the teeth was occasioned by particles of sweet things remaining between the teeth. The Greeks and Romans indulged freely in sweet fruits, and their pastry receipts called for the liberal use of honey, preserved dates, etc. Sugar was first mentioned by Theophrastus (born 372 B. C.), a Greek philosopher, who wrote several books on the history of plants. It was not until 1471 that a process for refining sugar was discovered by a Venetian.

Modern Tribes and Isolated Nations

African negroes, American Indians, the Maori of New Zealand, the Eskimos, and some of the natives of the South Sea islands are either living in parts of the world not easily accessible to com-

merce or remain untouched by civilization. Their habits are simple, they live under natural conditions, and their diet is restricted to the local supply of food. The Eskimos eat flesh, fat fish, birds, and a number of plants, such as reindeer-moss and berries of various kinds. In the wilds of Africa and New Zealand meat is not always procurable but is indulged in when at hand. The staple foods consist of native fruits and grains, which vary widely according to the locality, millet, maize, and manioc being used. The roots of plants, such as sweet potatoes, sweet roots of the ti-tree, the rarah or fern root, and berries are eaten in quantity.

The preparation of the food is, as a rule, extremely crude. The teeth are depended upon a great deal for a final preparation and therefore are given considerable exercise. After meals, fresh water is taken freely, a habit which in some cases has become a tribal custom. Decay of the teeth is very rare among these people.

Dr. Stanley Colyer, in his African researches into the cause of dental caries, states that the Barotzi and other tribes living near or upon the Lakes Mweru and Bangweulu are remarkably free from caries, while in the Transkeian territories, where sugar has been introduced and is

eaten in considerable quantity, both raw and in food, and where it is given to children to pacify them at night, dental caries is extremely common.

The Moors, a people of very ancient civilization, place great value on a good set of teeth, as is evidenced by the fact that slave dealers always examine the teeth and gums before purchasing; but, notwithstanding this, their teeth are poor. Professor Pickerell writes, "They partake freely of various kinds of confectionery and it is, therefore, not surprising that the native doctors are acquainted with and use three different kinds of instruments for extracting teeth."

In Asia Minor, especially in Persia, dental diseases are also extremely prevalent. The food is heavy and difficult to digest, and the sedentary life, especially of the women, is the cause of many maladies. Honey and sugar are used in great quantities. Between meals, sweets of native fabrication and bad quality are eaten continually by the women and children. As for drinks, coffee, tea, orangeades, and lemonades with plenty of sugar are used.

The Peasant Classes of Europe

The immigrants at any of our port stations coming from the agricultural sections of Italy,

Greece, and the Balkan states, from Germany and Poland, have strong, healthy teeth, caries being the exception rather than the rule. It will be found that their diet consists mainly of coarse food, plenty of vegetables, and fruit. They are accustomed to preparing their grain at home or in a local mill. The only bread made is dark, and even this is never eaten when fresh. White flour and, above all, refined sugar are luxuries. Sweets and desserts are reserved for the Sunday meal, or are indulged in only on very special occasions. Many state that they have never cleaned their teeth, but, after all, coarse food is the best cleanser, and with proper diet no particular care of the teeth is necessary.

The Effect of Modern Civilization

In centers of civilization the demand for new and agreeable sensations has created the Epicurean tastes which crave highly concentrated food. Refined sugar to-day is used in abundance for cooking and is added in ever-increasing amounts at the table. The eating of sweetmeats and candies, good and bad, between meals, for the sake of the flavor, is one of the most pernicious habits, and is prevalent among poor and rich alike, and in the country as well as in the cities.

Other foods, for the sake of appearance, are subjected to elaborate chemical and mechanical manipulation, or are spoiled by the modern process of cooking.

Dental Conditions in the United States

The Mayo Clinic examination of fifteen hundred patients showed that 87 per cent. had infected teeth and 80 per cent. suffered from pyorrhea. This gives some idea of the prevalence of dental disease among adults in this country.

The poor condition of the teeth of the average child is shown by reports from examinations made by Dr. Fones in the schools of Bridgeport, Connecticut. He states that 98 per cent. of the children examined during a period of five years had irregular teeth, and that 1946 pupils of the fifth grades, examined in 1915, had 2906 cavities in the temporary teeth and 10,726 in the permanent teeth. This is an average of five and one-half cavities in the mouth of each child. A dental examination of the Marion school in Cleveland, Ohio, made in 1919, showed that of 846 children only three were found whose teeth were in perfect condition. One was a colored boy eleven years old, another a Slav girl of ten years who had been in America about six months and the third was

an American-born child, twelve years old, of Russian parentage. These statistics are startling, but they are typical. The same lamentable conditions seem to exist also in Great Britain. The British Dental Association reports that 86 per cent. of the English and Scotch school-boys and -girls are afflicted with decayed teeth. In New Zealand the percentage is 95; in Hamburg, Germany, 96.4.

The development of good, sound teeth affects more than the individual's health; it affects the efficiency and welfare of our nation. Poor, diseased teeth made thousands of men unfit to join the army during the war. One out of every five of the first draft in Massachusetts was rejected on account of deficient teeth. Diseased teeth rob industry. A large company in Ohio states that the establishment of a dental clinic in their plant saved them 21,031 hours in six months. The financial loss to the country as a whole, because of the never-ending relief and repair work, is so enormous that even an approximate estimate is impossible.

Summary

This historical review brings out the fact that the ravages of dental disease increase in direct

proportion to the advance of civilization. This fact was recognized nineteen hundred years ago by Celsus, who thought that in ancient times the health was well preserved on account of good habits, but that intemperance and idleness, two vices which appeared first in Greece and later in Rome, brought with them a multitude of evils. Without doubt, the methods of living in our own age have an important bearing on the health of our teeth. Modern diet lacks, as we shall see later, vitamins and calcium salts. Important constituents of our food are destroyed by fabrication, refining, and intensive cooking. Yet these elements are essential, not only to good teeth, but to good health in general. The most important factors, therefore, must be those concerning regimen and diet. After the reader has been made familiar in the following chapters with the causes, nature, and consequences of the different dental infections, this subject will be taken up again, because it is the key to prevention, and prevention alone is the door through which we can enter into immunity from dental disease.

CHAPTER III

DEVELOPMENT OF THE TEETH AND FACE

“There is no cut like cutting teeth.”

The variations in the form and size of the teeth in different animals and in individuals of the same species are an interesting study. The reason for the development of these variations is an example of the wonderful work of nature.

Philosophers and scientists for centuries have found material for thought and discussion in the study of variations in animals and the changes that have taken place in their organs. Aristotle thought these changes could be explained by the law of economy of growth. Lamarck, a French zoölogist, believed there were two agencies at work: first, adaptation by means of use and habit, and, second, heredity transmitting the changes to the offspring. Darwin also believed that use and disuse of organs was a very important factor in organic development, but he discovered a third principle, which he took to be the chief agent in the transformations of evolution, namely, natural selection, or the survival of the fittest in the

struggle for existence. Under changed conditions the animal which has best adapted itself to the new conditions has the best chance to survive. A wild boar, with well developed cuspids protruding from its mouth, can readily kill its foe, while with underdeveloped teeth it would succumb in the battle.

Evolution of the Teeth

When animals were forced to change their habitations, some had to live upon different food, which demanded more powerful jaws and stronger, specialized teeth. Changes were produced in their shape, size, form, and number. From corn-like projections they developed into the primitive cone-shaped tooth still seen in some fish and reptiles. Animals with this type of teeth usually had extremely long jaws and a great many teeth. They served merely to take hold of the food, which was swallowed virtually without mastication (Figure 6). In a later period, when some had to live upon food which required more powerful jaws and stronger teeth of special shape, a remarkable change took place. The jaws became shorter, giving greater strength to the bite. The shortening of the jaws necessitated a reduction in the number of the teeth, which was accom-

plished in two ways: first, by eruption of the teeth in two sets, and, second, by fusing the simple teeth into more complicated forms. In this fashion teeth with two, three, and four roots and as many cusps were formed, which in time arranged themselves in the jaw so that they interlocked in a manner most efficient for mastication. As time went on, the teeth became altered to perform a variety of functions. Animals formed special food habits and developed carnivorous, insectivorous, and herbivorous types of dentation even as long ago as the giant saurians lived.

The front teeth (incisors) are formed for cutting action. They are used to tear meat from bones, to browse on grasses; and in rodents these teeth grow continually as they are worn from gnawing. The canines (cuspids) serve the greatest variety of purposes and therefore show the most interesting forms. Beasts of prey have the strongest and most prominent cuspids—fang teeth, which sufficiently describes their use (Figure 7). In other animals they have become formidable weapons, as in the wild boar, the elephant, and the walrus. The babirusa hog, an animal native to the Malay archipelago, has curved tusks, by which it is said to hang from branches when resting or escaping from an enemy (Fig-

ure 8). In animals that crack nuts or break bones, the cuspids serve as a guide for the jaws so that they will not slide past each other. They would be a hindrance to the lateral motion, necessary for proper mastication in herbivorous animals. Therefore, their cuspids are either underdeveloped or entirely missing.

The back teeth (bicuspid and molars), are the teeth that grind the food, and their form differs according to the diet of the animal. In the carnivora we have teeth with sharp edges, which cut like scissors, as meat does not require grinding and the teeth are used only to cut and tear (Figure 7). The herbivorous animals have the most complicated teeth, with crests and ridges for most efficient mastication, since there is very little nutrition in grasses. The omnivorous and fruit-eating animals and man have broad-cusped molars, because mastication of the vegetable, fruit, and cereal foods is necessary before digestion.

How the Modern Human Face Developed

Go back with me to the earliest time of man, the time before the use of fire, when the human being lived under the same conditions as the anthropoid apes, when his only occupation was to hunt for food and defend himself against the

attacks of enemies; and you will understand the changes brought about during thousands of years. Physical strength was the greatest asset of prehistoric man, and the kind of food upon which he lived required massive jaws, with large, strong teeth, which resulted in a prominent mouth and face. His brain case was small and flat, as it is still, in a modified degree, in the African negro. When he began to use his wits and develop more and more his mental faculties, a wonderful change took place. The brain case became larger, and, through his acquired ability to obtain and masticate food with much less expenditure of strength, his face and mouth became less prominent. If you compare those cave-dwelling times, when man was a creature with hardly any thought except for food and protection, with our twentieth-century life, its gigantic demands upon the brain, and its diet prepared by modern cooking, you will understand why, with civilization, has come a development of the cranium at the expense of those parts which were so vital to our ancestors in obtaining food.

The inherited modification in the size of the jaw has been brought about by the decrease in its use, generation after generation, because of eating softer food. The same influence has also

caused changes in the appearance of the nose and other features.

The Deciduous Teeth

Of the first set of teeth, variously called deciduous, temporary, or milk teeth, the first to appear are the central incisors, the lower ones coming first, as a rule. The normal time for their eruption is between the sixth and eighth months. As the infant is usually nursed up to this age, it naturally needs no teeth during that period. Sometimes mothers worry if the teeth are late in beginning to erupt. This, however, is of no consequence. The second, or lateral incisors, erupt between the seventh and ninth months. Next come the first molars between the fourteenth and fifteenth months, then the cuspids between the seventeenth and eighteenth months, and finally the second molars between the eighteenth and twenty-fourth months, at which time all the twenty deciduous teeth have erupted.

Breast vs. Bottle Feeding

Deformities of the face are asserted, by some authorities to be due to bottle feeding, because little work is required to draw the milk from the bottle, and the motion is that of applying suction.

A bottle-fed infant, therefore, does not develop certain muscles, while the breast-fed child, who has to put considerable effort into his feeding, exercises a great deal the muscles of the mouth and tongue. Breast feeding includes kneading and munching movements, which stimulate the growth of the jaws. The fact that the food from the bottle comes so easily may even at this early age develop a habit of swallowing without mastication. The baby's mouth should be cleaned after every feeding with cotton dipped in a solution of boric acid.

Disturbances caused by the eruption of the deciduous teeth can be avoided to a great extent, and the parents who apprehend this period can do a great deal to avoid such trouble by giving babies stale, hard bread-crusts, on which they love to gnaw and nibble. The front teeth are not so bad, but the cuspids and molars are more liable to cause trouble. When a tooth is ready to erupt the gum immediately over the erupting tooth appears white. It takes from two days to a week for a tooth to erupt. Pain may be due to pressure against the gum by the tooth in its effort to break through. This can easily be relieved by an incision, for which a dentist or physician should



FIG. 6. JAWS OF A DOLPHIN

Showing primitive mouth with many teeth of the same shape. Only part of the head is shown.

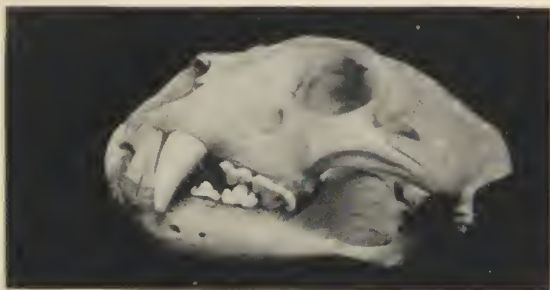


FIG. 7. SKULL OF A TIGER

Showing back teeth flat for scissors action, canines strong and prominent



FIG. 8. SKULL OF A BABIRUSSA HOG

Both the upper and lower cuspids have developed into tusks of enormous size

be called. Pain may also be associated with an inflammation caused by food or infection penetrating underneath the gum lying over a partly erupted tooth. The gum then has a very red and inflamed appearance. When the teeth begin to erupt it is especially important to wash the mouth thoroughly after every meal with a swab of cotton saturated with a solution of boric acid. This solution should be freely applied to inflamed gums over partly erupted teeth. As soon as the teeth are erupted they should be brushed daily with a small, soft tooth-brush.

The editor of "The Lancet," an English medical journal, writes, "The firm belief among the laity of all classes that the baby must be more or less ill whenever he is cutting a tooth has led, even among the best-intentioned mothers, to an enormous amount of neglect of the first symptoms of illness in infants, and that is the way thousands of infant lives are sacrificed to the fetish of teething." If a child shows signs of illness, though you may think, comes from the teeth, consult a child specialist, and in most instances you will find that the child's teething trouble is in reality a stomach or intestinal disturbance, or perhaps only a common cold.

The Child Two to Six Years Old

The greatest progress in growth and development of the body is made during the period when the child is from two to six years old. At the age of two, when all the deciduous teeth have erupted, the child's diet should contain not only plenty of mineral salts, which are needed for bone and tooth development (see chapter on diet), but should also include hard foods, which require a great deal of mastication. A set of healthy teeth is necessary for good digestion and to get all the nourishment out of the food, as well as for the local effect of mastication—stimulation of growth and development of the jaws and teeth. The child's teeth during this period should be well taken care of; they should be brushed after every meal, and food which promotes decay (see chapter on caries) should be kept away. If cavities form despite the best efforts of the parents, they should be attended to while small by a dentist. If the child does not masticate properly the reason should be found at once. It may be due to formation of the habit of bolting the food (bottle-fed babies should be especially watched), to the fact that the child has received nothing but soft foods

which did not require chewing, or because he has been allowed to wash the food down, unmasticated, by drinking with each bite. Most children like to get the mouth as full as possible. This is said to be due to the fact that the taste-buds are much more active in a child's mouth and are best satisfied when the mouth contains a great deal of food. The lips are also supplied with taste-buds, and this may be one of the reasons why children are fond of smearing food over the outside of the mouth. If a great deal of food accumulates in a child's mouth without being swallowed, a large bolus forms, which finally cannot be got rid of. Parents should be warned against allowing the child to wash his food down with water, or else it will be done again and again. Teach children to take a small mouthful, to masticate it well and swallow it before taking more.

If a child is made to eat hard food, the jaws develop properly and spaces appear between all the teeth at the age of five. This should not disturb parents, because it is a normal condition and is a sign that the permanent teeth will have a chance to erupt normally. This spacing provides room for the permanent teeth which at this time are already partly formed in the jaws, and the

crowns of which are much wider than those of the deciduous teeth.

Eruption of the First Permanent Molar

The mistake of supposing that the first permanent molar is a deciduous tooth is often made by parents. The first permanent molars erupt without a deciduous tooth being shed, and, because they are far back in the mouth, they are not easily observed. It is a great pity that parents do not understand the importance of the first permanent molars, which are the cornerstones, so to speak, of the second dentition. Very often they are allowed to decay. The first or six-year molars, so-called because they normally erupt when the child is six years old, should be carefully watched for. They are sometimes poorly calcified, and we find fissure defects, which invite decay just as soon as they have penetrated through the gum. It is important, therefore, to prevent decay by treatment of such defects as soon as these teeth erupt.

The Permanent Teeth

Animals shed their deciduous teeth while eating; they are broken out when biting into hard food. In man the process is not always so simple,



FIG. 9. X-RAY PICTURE OF THE TEETH OF A GIRL ABOUT ELEVEN YEARS OLD

The first deciduous molar has been lost. The first bicuspid (A) is about to erupt. The roots of the second deciduous molar (B) are becoming absorbed, and the second bicuspid (C) is developing below. The first permanent molar (D) is in its place and has already been filled. The second permanent molar (E) is still in the jaw, the roots are not completed, and the third molar, or wisdom-tooth (F) is only partly formed, only the cusps being calcified

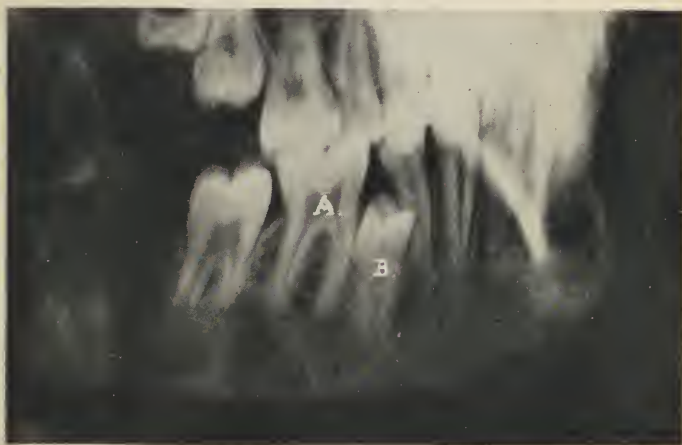


FIG. 10. X-RAY PICTURE OF THE TEETH OF A CHILD TWELVE YEARS OLD

Early loss of the second temporary molar closed up the space. The molar (A) moved forward so that there is not enough room for the second bicuspid (B) to erupt

and the deciduous teeth are sometimes retained too long. This, as well as their premature loss, causes irregularities in the permanent set. The permanent teeth develop in the jaws while the deciduous teeth are still functioning. At the age of six years, the crowns of most of the permanent teeth are completed, but the roots are not entirely formed. As they develop and require more and more room, the roots of the deciduous teeth become absorbed until the surrounding bone no longer holds them, and they become loose (Figure 9). If the process is normal and enough hard food is taken, the deciduous teeth will be broken out during mastication, as in animals. If they are not lost and replaced at the right time, as indicated in the table on page 39, after allowing a reasonable time for individual variation, a dentist should be consulted.

By means of X-ray pictures it is possible to determine conditions. When no permanent teeth have cut through the gum they are generally to be found developing in the jaw. If conditions are disclosed which would prevent the normal eruption of the teeth, steps should be taken toward correction. An X-ray of such a case is shown in Figure 10. The little patient, a girl twelve years old, had lost her deciduous molars several years

before. They decayed, abscessed, and had to be extracted. The molar A moved forward, closed the space, and prevented the second bicuspid (B) from coming through.

Eruption of the Permanent Teeth

When the deciduous teeth are lost, the permanent ones should take up the vacated space at once. An unoccupied space caused by the loss of a deciduous tooth before the permanent one is ready to erupt is generally partly closed up, because the back teeth have a tendency to move forward, with the result that when the permanent tooth finally makes its appearance it is forced to the outside or the inside of the dental arch.

The time of eruption of the permanent teeth is found in the table on the following page. The twenty deciduous teeth are replaced by the permanent incisors, cuspids, and bicuspids. It should be noted that the incisors erupt first, the bicuspids next, and the cuspids last. The three permanent molars, which do not succeed any temporary ones, take their place in the back of the jaw as it increases in length. The eruption of the first permanent molar takes place at the age of six, as already described. The second molar erupts

CHRONOLOGY OF HUMAN DENTITION

<i>Tooth</i>	<i>Time calcification begins</i>	<i>Time calcification is completed</i>	<i>Time of eruption</i>	<i>Time tooth shed</i>
Temporary Teeth	Central incisor	4th fetal month	17th-18th post-natal month	7th year
	Lateral incisors	4th fetal month	14th-16th post-natal month	8th year
	Cuspids	5th fetal month	24th post-natal month	12th year
	1st molars	5th fetal month	18th-20th post-natal month	10th year
	2d molars	5th-6th fetal month	20th-22d post-natal month	11th-12th year
Permanent Teeth	Tooth			
	Central incisor	1st year	10th-11th year	7th-8th year
	Lateral incisor	1st year	10th-11th year	7th-8th year
	Cuspids	3d year	12th-13th year	12th-13th year
	1st bicuspid	4th year	11th-12th year	10th-11th year
	2d bicuspid	5th year	11th-12th year	11th-12th year
	1st molar	8th fetal month	9th-16th year	6th-7th year
	2d molar	5th year	17th-18th year	12th-14th year
	3d molar	9th year	18th-20th year	17th-20th year

The lower teeth generally precede those in the upper jaw by short intervals.

when the child is twelve years old and is called the twelfth-year molar. The third molars, popularly called "wisdom-teeth," are the last to erupt, and when they are all present the second dentition is completed. This usually occurs between the ages of eighteen and twenty, when the mouth contains thirty-two teeth.



FIG. 11. LOWER ASPECT OF A DOG'S SKULL

On the left side in the picture, the teeth were extracted to eliminate performance of their function. The effect of this on the growing dog was unilateral development of the entire skull. From the horizontal line A-1, drawn across the base of the skull, a vertical line, A-2, was drawn. Normally this line would lie in the median line of the skull. The picture shows how the entire jaw and the nose have grown toward the left, on account of the retarded development of that side

Courtesy of Dr. Lawrence Baker, Harvard University Dental School

CHAPTER IV

ABNORMAL DEVELOPMENT OF THE FACE AND

IRREGULARITIES OF THE TEETH

“As the teeth are, so is the bite.”

Apollo of Belvedere was the ideal of the Greeks, and his beautiful face is still held to be a fine example of harmony and proportion. Artists have ever sought to establish basic principles, by means of which deviations from a standard might be detected. To-day, however, and especially in our country, where many types exist, the facial proportions are influenced by the different physical, mental, and moral habits of a large number of races. The question, therefore, is principally one of balance and symmetry, and it has been found that any departure from the full complement of the teeth or their normal position will cause discord in the proportions of the mouth and other features.

Experiments were made by Dr. Lawrence Baker of the Harvard Dental School on guinea-pigs and dogs, to determine how important a

rôle mastication plays in the growth of the face and jaws.

He selected young animals and extracted or ground the teeth short on one side so that mastication was possible only on the other. The result was very remarkable. There was a decided difference in the development of the two sides of the jaws. The side where the teeth were left and where mastication was normal developed much more than the unused side. Not only were the jaws affected, but the entire head, including the cheek-bone and nose, presented an unilateral development, the whole face being twisted to one side (Figure 11).

Children sometimes form a habit of masticating on only one side, with the result that the two sides of the face develop unequally, just as in the guinea-pigs and dogs. One cheek then becomes larger than the other, with unusual folds and a difference in the length of the lips. The real underlying cause is generally some painful condition of a tooth, which makes the child favor it by masticating on the opposite side. The early loss of a number of teeth on one side may have the same effect. Another cause of unequal development of the face was found in the instance of a child who had never had a deciduous nor

permanent lateral incisor in the right side of the upper jaw. His lips were shorter on this side, and the corner was drawn up a little.

Idiotic, Criminal, and Insane Types

Abnormal proportions of the face and head are often a great handicap. Many investigators assert that there exist idiotic, criminal, and insane types of faces. Talbot, in his book, "Developmental Pathology," states, however, that his study of facial deformities precludes this statement. The facial characteristics associated with idiocy, criminality, and insanity may be found in people varying in mentality from the lowest idiot to the most intellectual scholar.

An open mouth, with the teeth of a narrow, protruding upper jaw projecting from under the lip, and with a receding chin, gives an appearance of weakness to the face. The narrow, V-shaped upper jaw with a high vault may cause a narrow nose, and the child is likely to have a dull, listless expression.

Adenoids and other unhealthy conditions of the nose are very liable to occur in children with narrow jaws and a high, narrow palate, which is associated with contracted nasal passages. These conditions can be prevented and overcome by

mastication of hard food, which influences the formation of a wide dental arch and will produce a wide space in the anterior part of the nasal cavity, since the roof of the mouth is also the floor of the nose. The pull of certain of the muscles of mastication (pterygoid muscles) also exerts an influence on the back part of the nose (the nasopharynx), and their vigorous use tends to widen this space. The augmented circulation brought about by the muscular activity of mastication has a beneficial influence on the oral as well as the nasal tissues. This fact should be remembered by the speaker and the singer. A well preserved set of teeth and their energetic employment for mastication will preserve the health of these organs, so important in such professions.

Mouth-Breathing

Observe a child with a narrow jaw and face, and you will find that he opens his mouth just as soon as he runs. .

The constricted nasal passages cannot accommodate the passing of a sufficient amount of air to supply the blood with the additional oxygen required by the increased physical activity. He has to breathe through the mouth, allowing the



FIG. 12



FIG. 13



FIG. 14



FIG. 15

FIG. 16

Fig. 12 shows the typical appearance of a mouth breather. Note the protruding teeth

Fig. 13. Profile of the same boy before treatment

Fig. 14. Profile after treatment. The mouth is now closed, and the upper lip has been brought back

Fig. 15. Condition of the upper teeth of a mouth breather

Fig. 16. Upper teeth after treatment, in normal position. Note the difference in width of the mouth.

air to enter the lungs unfiltered, unmoistened, and cold. This, however, is not the entire damage done. If the mouth is constantly open the muscular balance of the mouth is overthrown. Normally the teeth receive as much pressure from the outside (the muscles of the cheek) as from the inside (the muscles of the tongue). With the mouth open the tongue exerts no pressure, which allows the cheeks to make the bad condition worse, the upper jaw becoming still narrower and the nose more compressed.

If your child is a mouth-breather, first of all have him examined by a good nose and throat specialist. He is likely to find adenoids. Do not think, however, that removal of the adenoids will solve the problem. They may form again unless the jaws and face are widened by regulation of the teeth. Breathing-exercises will be found to be of great benefit. Have the child stand in front of an open window, breathing slowly through the nose, with the arms and shoulders extended back. The lungs should be filled completely, after which the air should be quickly expelled. This exercise should be repeated twenty times at least three times a day.

In a typical case of mouth-breathing the patient was a boy who was treated in the orthodontia

clinic of the Harvard University Dental School. Figure 12 shows his normal appearance before treatment. The mouth is open, and the central incisors protrude, which is typical of the mouth-breather. In Figure 13 we see a profile view, also before treatment. This shows how the upper lip protrudes and the chin recedes. The condition of the teeth of a mouth-breather is shown in Figure 15. The jaw is extremely narrow and compressed from side to side, so much so that the teeth have not room enough and are in very irregular position, both in the front and back of the mouth. Figure 16 shows how the teeth can be improved, the arches widened, and the teeth brought into their normal relations. The improvement in the face is shown in Figure 14. In this photograph of the same boy after treatment, we see that he is now able to close his mouth without effort, and that his profile is very much better.

Protruding Lower Jaw and Depressed Upper Lip

A protruding lower jaw is generally due to an irregular position of the teeth, but it may be due to heredity. This peculiarity of face formation sometimes is transmitted for generations. A notable example is that of the Hapsburg family.

The unnatural prominence of the chin and lower lip is usually associated with a flat upper lip and depressed nose. Another boy, which is also a case from the orthodontic clinic of the Harvard University Dental School, shows this type. The profile of the boy before treatment, which is typical, is shown in Fig. 17. Note the protruding lower jaw and sunken upper lip. The condition of the teeth in a case of this type is shown in Figure 19. The lower jaw not only protrudes too far forward but also extends beyond the upper jaw on each side.

Deformed jaws may be due to pernicious habits. Of these the most important are thumb-sucking, which, through pressure on the upper teeth, results in protrusion of the upper jaw. Sometimes other fingers, or the lips, are sucked, which affects the teeth in the lower jaw, while wrist-sucking produces a deformity known as an open bite, the front teeth being apart when the back teeth are together. The use of pacifiers will also result in similar conditions. The tissues of the child's jaws are very tender in the early part of his life and respond surprisingly well to continual pressure.

Pernicious habits should be corrected at the very beginning and in an unobtrusive way. In-

stead of correcting the child and scolding him when he sucks his thumb, remove it gently from his mouth and get him interested at once in something else. Only in very stubborn cases is it necessary to use aluminum mittens, or to pin the night-dress sleeves to the sides, so that the hands cannot be raised.

Short jaws, allowing insufficient room for the permanent teeth, are one of the principal causes of irregularities. They can be corrected by giving the child, as soon as possible, hard food which needs to be thoroughly masticated. Mastication is among the most important factors in stimulating development of the jaws by increasing the blood-supply and furnishing additional nutrition to the bones and teeth.

Deviations from the normal in the arrangement or position of the teeth or the formation of the dental arches is designated by the term "malocclusion." Irregular teeth are due principally to underdeveloped jaws, but they may also be caused by premature loss or too long retention of deciduous teeth and by extraction of permanent ones, which allows tipping and drifting of the teeth on each side of the space.

In the Bridgeport, Connecticut, schools Dr. Fones found that out of 6768 children in the first



FIG. 17. A boy with protruding lower jaw. Observe the profile, the shape of the nose and position of the upper lip.



FIG. 18. The same boy after treatment. The chin has been brought back into normal relation and the lips and nose show marked improvement



FIG. 19. Models of the teeth in a case of protruding lower jaw. All the teeth in the lower jaw protrude, and the back teeth on each side extend beyond the upper ones

All of the above figures are used by courtesy of the Orthodontia Department, Harvard University Dental School

and second grades 98 per cent. suffered from malocclusion. As irregular teeth are very hard to keep clean, they decay much more easily than those in proper position. In pyorrhea, as we shall see later, the abnormal strain caused by the improper locking together of irregular teeth is an important contributory factor.

Many people believe that it is not necessary to take care of the deciduous teeth, since they are lost later anyway. This is a great mistake. The first set of teeth is of great importance. This should be stated with particular emphasis, because neglect of the deciduous teeth has serious consequences. If any of the deciduous teeth are lost prematurely it will cause trouble with the eruption of the permanent set.

Prevention of Malocclusion

Exercises are recommended by Dr. Alfred Rogers, one of America's leading orthodontists, to prevent as well as to correct certain abnormalities. He states that splendid results can be obtained by simple exercises if the child's cooperation can be secured. Nature provides a normal condition to start with. Malocclusion of the deciduous teeth is rare, and any tendency toward an abnormal condition can easily be coun-

teracted if discovered early. One of the most important means of prevention is stimulation of bone growth and tooth development through mastication of hard food, and if the deciduous teeth are well taken care of there is no reason why the permanent ones should not erupt normally.

The psychological attitude of children is of great importance. The child who has been frightened is suspicious and difficult to handle. Parents should, therefore, be very careful not to make any of those mistakes which spoil the dentist's most conscientious efforts. If little Johnny sucks his thumb, do not tell him that unless he stops he will be taken to the dentist, who will put wires on his teeth. Such comments make a deep impression on the child's mind and, when he needs treatment later, will make him an unwilling and remonstrative patient. It is just as bad if the parents express in little Marie's presence their pity that she has to undergo such lengthy treatment and promise her that it will not hurt and that she must be brave. Such suggestions, with their implication of pain, are hard to counteract. They are breeders of fear. Negative suggestions are as bad as undesirable positive ones.

The child's coöperation should be secured by stimulating his interest in the expected result of

the treatment. If the little patient can be made to look forward to having beautiful, straight teeth, he will be glad to have the work done and will do his share to help as much as possible. Keep away the thought of pain entirely. If injurious suggestions have not taken root, the dentist has an opportunity to secure the child's confidence, which makes the treatment easier for all concerned. There is no pain and very little discomfort if the teeth are regulated slowly and skilfully.

The younger the child when the treatment is begun, the better will be the result. If any abnormal condition is discovered, an orthodontist, or a dentist who understands the principles of orthodontic treatment (regulation of the teeth), should be consulted at once. Between the ages of five and eight the best results are obtained, because the treatment causes stimulation of bone growth, not only of the bone, so that the permanent teeth may find room enough to erupt in their proper places, but also of the jaws, the nose, and the entire face.

When regulation of the teeth is begun late, between the ages of twelve and eighteen, that is, after the permanent teeth have erupted, a harmonious result cannot always be obtained, the

treatment having little effect on the facial development. The result often is that the teeth are too prominent for the size of the face, making the child appear to be "all teeth." There are, however, other ways to overcome such a condition. Some time ago I saw a girl about fourteen years old with very pretty features but very irregular teeth. After careful study it was found that she had inherited extremely large, broad teeth, for which there was not sufficient room in her mouth. Instead of trying to gain room for the teeth by widening the dental arches out of all proportion, space was produced by extracting four bicuspid, one on each side in both the upper and lower jaws. After the teeth were straightened the result was very pleasing. Such treatment, however, is not advisable except in extreme cases and should only be resorted to after careful consideration and expert advice; but it is one of several ways of correcting a condition that has not received attention during the time when a harmonious result could most easily have been obtained.

Unrupted and Impacted Teeth

Civilization is declared by certain investigators to be the cause of the jaws' becoming shorter,

and the tendency toward reduction of the dentition, in size as well as in number of the teeth, is laid to the same influence. Some teeth, especially the lateral incisors and third molars, have become very much smaller. In some individuals they are even absent entirely, and it is the belief of certain scientists that in a few thousand years the human dentition will be reduced from thirty-two to twenty-four teeth. At present we are supposed to be going through a period of transition, during which the shortening of the jaws does not allow room enough for the present size and number of the teeth.

The interesting observation that occasionally we find some one with more than thirty-two teeth, can be explained in a similar manner. The development of a fourth molar, a third or even a fourth bicuspid, or a third incisor is supposed to be a retrogression to a lower type, there being four molars, four premolars, and three incisors in the mammalian dentition.

If you suffer from an impacted tooth that has not sufficient room in your jaw you may wish yourself born a few thousand years hence, when the wisdom-teeth have disappeared. You deserve sympathy, but do not forget that the same influences which tend to reduce the number of the

teeth will also continue further to decrease the length of the jaws. The trouble we are having now with the third molar would in all probability then be transferred to the second molar.

When the third molar is ready to erupt, if there is no room for it, it is often forced into various positions and finally becomes locked, or impacted, by the second molar or the bone. The exact location of the tooth can be determined by means of an X-ray picture.

In some instances impacted teeth remain entirely buried in the jaw, no matter how long you wait (Figure 20, A); others come partly through the gum, but the impaction makes it impossible for the tooth to come through entirely (Figure 21, B). In this partly erupted state they very easily become infected.

Pain and locking of the jaws often accompanies the infection. In severe cases the muscles become so tight that the mouth cannot be opened enough to allow mastication of food. The removal of the offending tooth becomes necessary, and a dental or oral surgeon should be consulted without delay.

In a typical case, the patient found it difficult to swallow, and the throat was so sore that he consulted a throat specialist. He was unable to

open his mouth wide enough for an examination, but said that he had had trouble several times with a partly erupted wisdom-tooth. The physician referred him to the writer for an X-ray examination, which showed evidence of infection around a partly erupted third molar. Removal of the tooth cured the condition.

On account of its being the last tooth to erupt, the third molar is the one which most frequently gives trouble in this respect. Of the other teeth the cuspids are the most frequent offenders, because they erupt later than the two adjoining teeth. An impacted bicuspid is shown in Figure 10.

Pain and Pressure from Impacted Teeth

Intense, sharp, throbbing, or dull pain may be caused by impacted teeth, but sometimes there is only a sensation of obscure, indefinite pressure. These symptoms may be referred to any part of the head and are caused either by the tooth pressing against the obstruction or the roots against the nerve-trunk in the lower jaw.

Unable to continue his studies at school, a young man about nineteen years old was sent to the writer for examination. He complained of headaches in the region of the forehead and an in-

definite sensation of pressure in the back of his head. At times these symptoms disappeared entirely, only to be followed again by a period of suffering. X-ray examination showed unerupted, impacted wisdom-teeth on both sides of the lower jaw, the roots being in close contact with the nerve of the jaw. After I removed these teeth for him, he was entirely relieved.

Irritability, sulkiness, ill temper, and delinquency may be the result of constant dental irritation from irregular eruption of the teeth. There is a great difference between a child who is perfectly comfortable and a boy or girl who is kept continually uncomfortable by slight irritants of a physical nature. While in some cases there is no disturbance apparent, there are others where far-reaching effects may be produced by an unerupted tooth, disturbing the general psychological balance and affecting the child's future career and happiness in life.

Ear Pain and Neuralgia

As sound travels along a wire, pain travels along the nerves. On account of connections between the nerves leading to the teeth, ear, and other parts of the face, pain, like the sound in telephoning, may originate in one place and be



FIG. 20. SPECIMEN WITH OUTER BONE PLATE REMOVED TO SHOW THE INSIDE OF A LOWER JAW

A, unerupted wisdom-tooth, impacted in horizontal position



FIG. 21. SIMILAR SPECIMEN

The wisdom-tooth (B) is partly erupted. It is in a mesio-oblique position and is prevented from entire eruption by the second molar

transmitted to another. This explains why an abnormal condition of a tooth frequently causes a neuralgia in the ear, eye, nose, and other parts of the head. The origin of the pain is sometimes very difficult to find and requires most careful study. The X-ray is again an inestimable help.

A case in point is that of a man who consulted me as to the cause of a ringing and pain in the left ear. Examination of the mouth showed the upper third molar missing. An X-ray picture revealed the tooth impacted. The symptoms ceased with its removal.

Dr. Henry S. Upson of Cleveland, and Dr. Henry A. Cotton of Trenton, New Jersey, both distinguished neurologists, state that nerve irritation from impacted teeth may become the cause of very serious mental diseases, such as insomnia, melancholy, neurasthenia, epileptoid attacks, and mania. A well known doctor said, in discussing a paper on this subject, "I should not permit a friend of mine to be placed in an asylum for the insane or the mentally deficient without having his teeth thoroughly gone over."

Impacted teeth must be removed sooner or later. One should not wait until there is some disturbance, which might occur at an inconvenient time, but should avoid the possibility of future

trouble by choosing an early date for their removal.

The influence of civilization and the development of the intellect has, as we have seen, a deplorable influence on the physical make-up of the body of man, causing a deficiency in physique, a degeneration of important organs, and a disturbance of normal development. This tendency must, therefore, be corrected by proper living and by supplying artificially, by exercises and preventive measures, favorable influences, which will result in the restoration of normal development and functioning of the body.

It is necessary, therefore, to stimulate the growth of the jaws, the development of which is retarded in most children. This is the best way to create space for all the teeth and can be accomplished by a diet which requires mastication and which will be discussed more fully in another chapter.

CHAPTER V

DENTAL CARIES AND ITS EVIL CONSEQUENCES

“A decayed tooth injures its companions.”

Dental caries, or tooth-decay, as it is commonly called, is only the beginning of a long chain of diseases, which may culminate in serious involvement of the general health. There is no disorder afflicting the human race that is more common, and its wide distribution has already been described in Chapter II. From 85 to 95 per cent. of civilized people and even some household pets suffer from the disease.

Savages, upon whom we look down from our pedestal of modern culture, would turn away in disgust from people with mouths as unclean as those of many of the inhabitants of our cities. People of an intelligent race should make an earnest effort toward prevention of a disease so rampant and with so many serious consequences. The indifference of the general public should be replaced by a feeling of pride in the possession of a beautiful set of teeth. To bring up children

with healthy, normal teeth lies within the power of all, as we shall see later.

“My teeth are so soft they just crumble away,” is an expression often heard, and there is a great deal of truth in it. Hard and well formed teeth resist decay, while poor and defective tooth-substance easily falls prey to the attacks of disease. The quality of the hard tooth tissues depends upon the process of calcification, which in the deciduous teeth begins nineteen weeks before birth, and in the permanent teeth (the first permanent molar is the first to calcify) ten weeks before birth. The calcification of the crowns, which is the only part of the tooth exposed to caries, is complete in the deciduous set six months after birth and in the permanent set between the sixth and ninth years, except for the third molar, the crown of which is not finished until the twelfth year. It is, therefore, evident that in the first set of teeth the quality depends mainly upon the mother's supplying during pregnancy, as well as while nursing, the material necessary for strong teeth. The food that the expectant mother eats supplies, through her blood circulation, nutrition for the growth and development of the child. The mother's milk should contain all the ingredients needed. Vitamines and organic mineral

salts are of greatest importance for the development of bone and teeth, and can only be supplied during this period of life if the mother's diet contains an abundant supply.

All the permanent teeth, with the exception of the first permanent molar, begin to calcify after the child is one year old. At this age the child's diet, therefore, must contain all the vitamins and mineral salts in abundance. Unfortunately, our modern food is extremely deficient in these important tooth-builders, for reasons which will be explained later in the chapter on diet. On this account teeth are frequently of poor quality to begin with, and poorly calcified teeth are very susceptible to dental caries.

Strong, hard teeth do not necessarily remain so. The lime salts which are used in the formation of the teeth may become absorbed if there is a deficiency of lime salts in the body. This deficiency may be due to a diet particularly poor in lime salts. In regard to these salts it is interesting to observe that they are abundantly contained in those parts of our food which are usually wasted, such as the hulls of grains, fruit-skins, potato-peelings, and so on. Some of the lime salts are removed from food in the process of refining. Refined sugar, for example, is liable to do very

great harm, for when taken into the system it attracts the free lime salts, which then have to be supplied in excessive quantity to prevent a decalcification of the bone and teeth. A third and comparatively recently discovered factor is the function of the vitamins. It has been shown that lime and other salts cannot be used by the body, no matter in what form they are supplied, unless a vital agent or force is also present, such as the vitamins, of which we know three types. Our modern diet, however, is very deficient in these important substances, which will be dealt with more fully in the last chapter on diet. All this proves that our diet is not adequate, and it is evident that the teeth have a very poor chance of remaining in a condition in which they can successfully resist disease. If we realize that during the process of growth more lime salts are needed than in adult life, we can also easily understand why children are so much more susceptible to dental caries than adults.

What a Tooth is Composed of

To understand how a cavity forms we must first learn the construction of a tooth (Figure 22). The part which is visible in the mouth is called the crown. It is covered with enamel (E), a very

hard substance, which is devoid of sensation. This serves as a protection against outside influences. The root or roots of the tooth, which are connected by means of a membrane (peridental membrane), are covered with a layer of cementum (C). This is not visible under normal conditions, but when the gum recedes it becomes exposed and is often the cause of painful sensations. The bulk and inner part of the tooth consists of dentine (D), which is very porous, with many fine canals running through it and conveying sensations to the pulp. The pulp is contained in the hollow part which runs through the center of the root (P).

Immediate Cause of Dental Caries

Colonies of bacteria, called plaques, form on unclean tooth surfaces, especially in protected places and in imperfectly formed pits and fissures. These bacteria depend for nourishment on food, particularly on easily fermentable carbohydrates, of which the most important are sweets. These bacterial colonies are protected by a gelatine-like membrane from the neutralizing effect of the saliva, and underneath this membrane sugar and other carbohydrates ferment. Lactic acid is produced and comes into direct contact with the tooth,

dissolving its inorganic enamel. This is the first step in the formation of a cavity.

Influence of Refined Sugar

Sugar and all other sweets furnish food for the bacteria, which produce decay. The worst time to eat sweetmeats is between meals, and the abominable practice of some parents of giving their children candy as a bribe to induce them to go to sleep is a perfect method of inviting dental caries. The greatest harm, however, is done by the sugar when it is taken up by the body and begins its attraction of mineral salts, as described above. Free sugar is not a natural food, and the idea that children, or adults, for that matter, crave sugar because it is needed by the body is not based on sound reasoning. Contrary to prevailing opinion, sugar is not a food necessary to the development or nourishment of the body. Under certain conditions it forms an easily absorbed emergency food, which is valuable after exhaustive exercise, but in normal life all the sugar needed by the growing child or the adult is formed from starchy foods in the process of digestion. A so-called craving for sugar is, in fact, a desire to indulge in the pleasure of its flavor, which in time leads to the formation of a habit that is most dif-



FIG. 22. PHOTOMICROGRAPH OF A STAINED SECTION THROUGH A TOOTH WHICH HAD GIVEN PAIN BEFORE EXTRACTION

E, enamel; D, dentine; C, cementum; B, cavity; P, dental pulp, A, abscess in dental pulp, due to bacteria that entered from the decayed area, B; N, nerves of the pulp pressed to one side by the abscess

ficult to break, especially in children. A child who has never been permitted to indulge in sweets will eat cereal without sugar with as hearty an appetite as the one who covers his plate of oat-meal with it. It should be repeated that free sugar is not a natural food. Nature does not supply any food in such concentrated form, but man manufactures it from sugar-cane, sugar-beets, or the sap of the sugar-maple. Primitive man's only supply of sugar was honey, and honey is made by the bee for the bee. However, if one's children have already been brought up with the sugar habit, one can at least replace the refined sugar used in most candies and cooking with brown or unrefined sugar, maple-syrup, honey, or sweet fruit, such as figs, dates, and raisins.

Recently the writer went to see a little boy at his home. The writer was offered chocolates, and so was the boy. He accepted with great pleasure and said he was very fond of them. When asked how many pieces of candy he had had during the day he answered, "Only six." Apparently his mother did not consider that too much. Now, this boy was only four years old, he was thin and appeared under-weight, and when the writer looked at his teeth he saw a most pitiable condition. The writer mentally compared him with his own

boy of the age of five, who has never eaten candy and whose teeth are without blemish.

Effect of Caries on the Teeth

At first the process of decay is very slow, because the enamel, which covers the entire crown of the tooth, is extremely resistant. When the inner part, the dentine, is reached, tooth-decay progresses more rapidly, the dentine containing much organic matter, which furnishes food for the bacteria. It frequently happens, therefore, that a large cavity forms inside the tooth, when there is but a very small opening in the enamel. Because of the crushing in of the enamel of a large part of the tooth, which has become undermined, the cavity finally becomes noticeable (Figure 22, B).

In some people dental caries has done so much harm that the greatest skill of the dentist is required to make the mouth presentable where the destruction has occurred.

It is difficult to recognize caries in its early stages, and when we become aware of the condition we find to our regret that the harm done is considerable. A whitish, milky appearance of the enamel is a sign that it has been undermined, and if the cavity is deep a certain amount of pain

may be caused by sugar, sweets, salt, fruit, acids, and irritating food of any kind.

Examination and Treatment for Dental Caries

It is of the greatest importance that cavities be discovered at their beginning and treated at once.

As it is impossible for the individual to determine early cavity formation in his own mouth, frequent examinations are necessary. The best results are obtained when the patient has his teeth cleaned at regular intervals (see chapter on hygiene), thus giving the dentist an opportunity to find new cavities. Cavities, however, are sometimes not discovered by means of instrumental exploration, especially if they occur in obscure places, such as under the gum, or beneath a crown or filling. The writer advises frequent X-ray examination. Some of his patients have their teeth X-rayed once a year, and often it is possible to find, in this way, hidden decay which would have led in a short time to serious consequences.

The coming generation need not fall prey to the ravages of dental caries if the parents are willing to do their share. With a diet favorable for bone and tooth formations, strong, hard teeth can be developed. With prophylactic care, both

at home and at regular intervals at the dentist's, such teeth will not decay unless sweets and sugar are used in excess. A child does not crave sweets if it is brought up properly, but habits are formed early and are not easily corrected. If one has decided to save his child from the consequences of candy and other sweets, he must not let politeness stand in his way, and it is best to have an early understanding with his relatives and friends. If they insist upon feeding the child between meals, let them choose some food which does not give rise to such evils.

In the United States the consumption of sugar for each person is one hundred pounds a year. That is more than half the weight of an average adult. In Italy thirteen pounds per capita is used, which is about a teaspoonful a day, including that used in cooking. If sweets are indulged in by the adult they should be taken during the meal. He should never eat candy the very last thing at a meal, but should take some cleansing food, such as fruit, or rinse the mouth out immediately with water. Most people eat candy between meals, or just before going to bed. This is the surest way of furnishing a continual food supply for the bacteria, which causes tooth-decay to work night and day.

Involvement of the Dental Pulp

Wrongly but popularly called the nerve of the tooth, the dental pulp is contained in the pulp-canal, already described. It is made up of soft tissue containing blood-vessels to supply nutrition and nerves to transmit sensation (Figure 22).

Unless timely care is taken of a decayed tooth, bacteria, which abound in the cavity, will reach the pulp and cause infection. This is generally associated with pain, the kind that is at first aggravated by cold. Later it is intensified to extreme suffering when anything hot touches the tooth, while a cold application will result in relief. Under certain conditions the infection may proceed painlessly, even to the point where the entire pulp is destroyed. The condition is then spoken of by the laymen as a "dead nerve." Frequently the pain is referred to some other part, when it is called a neuralgic pain and can be traced only by the most painstaking examination.

A patient who came to me at one time complained of a pain which she had in the upper jaw. Careful examination of all the upper teeth on that side revealed nothing unusual. X-rays of the lower jaw, however, disclosed a large cavity in a molar, under the gum and beneath a filling.

Further investigation showed an infection of the pulp, and when this pulp was removed the pain referred to the upper jaw ceased.

Many people have pain in the ears, because of an infected tooth-pulp, which, however, gives no local trouble. In other cases the pain may be referred to different parts of the face, but always on the same side as the tooth. One young man who consulted the writer complained of very tender swellings under the jaw and in the neck. These proved to be lymph-glands. The teeth, so far as he knew, were all right. When making an X-ray examination, a cavity was found under a large silver filling in a lower molar. This cavity extended into the pulp-chamber. The pulp in that tooth must, therefore, have been infected, a conclusion which was borne out by the fact that the X-ray showed the infection to have already progressed through the ends of the roots and into the bone. When opened, an extremely putrescent pulp was disclosed. After proper treatment the glands become normal, and all the tenderness disappeared.

A diseased pulp must be removed. This deprives the tooth of its main blood-supply. As the tooth also receives nutrition from the outside, this would not be so serious were it not for the

fact that it is difficult to remove the infection from the root-canal. Sooner or later, either before, during, or after the root-canal treatment, the tissue around the root apex may become involved. Early attention to the decayed tooth, before the pulp has become infected, is, therefore, in the interest of the patient, since only under the most favorable conditions can we expect satisfactory results from root-canal treatment.

Infection of the Bone

If, for any reason, the treatment of the pulp is not undertaken, or is improperly executed, infection will spread through the opening at the end of the root into the tooth membrane and the bone. This will lead to the formation of an alveolar abscess, of which there are different types. Most people do not know, that, besides the acute abscess with swelling and pain, there is also another kind which forms and exists without giving any apparent trouble.

Alarming symptoms accompany the acute alveolar abscess, on account of which the treatment is very seldom neglected. It begins just as soon as the infection penetrates through the opening at the root end. An inflammation of the tooth

membrane sets in, and soon pus forms and destroys the surrounding bone. This pus after a few days burrows a hole to the surface, where it accumulates underneath the gum. Finally an outlet, or sinus, forms, either in the mouth or on the outside of the face.

At first the tooth is, as patients frequently express it, "too long." It is forced out of the socket, and every time the teeth are closed together it comes in contact first and causes pain. Later, pressure is exerted by the accumulated pus, and the pain becomes constant and is of a deep and throbbing character. The face begins to swell. If the tooth is in the upper jaw, the eye may become partly closed, and if in the lower the swelling often extends down the neck to a considerable extent. Just before the abscess breaks, the swelling on the gum has a whitish appearance, which is referred to as the pointing of the abscess. As soon as it has broken and when most of the pus has been discharged, the pain ceases.

Fever, with the temperature rising to as much as 104°F., preceded by chills, is not uncommon. Headache, flushing of the face, constipation, and highly colored urine are usually observed. In serious cases there may be delirium at night, and,

if the pus absorption is extensive, septicemia or blood-poisoning may result.

Relief of the pain and inflammation is the patient's first desire, but a speedy recovery without complications can only be effected by the prompt removal of the cause of the condition. This is generally diagnosed with the help of the X-ray, and the patient should, therefore, at once secure the services of a competent dental surgeon. It is a mistake to wait until the abscess quiets down.

Often the acute symptoms will subside without any treatment, or with the incomplete removal of the cause. The disappearance of the swelling and pain does not necessarily mean that total healing has taken place. On the contrary, pus discharge may continue in such cases through the sinus and may become a serious disturbance to the general health of the body (see Chapter VII). Should the reader happen to have a sinus in his own mouth, he can easily prove for himself that pus is discharged by pressing it with his finger.

The Blind Abscess or Dental Granuloma

The dental granuloma has received the popular name "blind abscess," not because it cannot see,

but because one cannot see it and because it causes so little local disturbance. In most cases its existence is entirely unknown and can be discovered only by means of an X-ray examination. It is generally caused by infection from a tooth from which the pulp has been removed and may have existed before the root-canal was treated or afterward. Instead of dissolving a large amount of tissue into pus, an abscess sac, or granuloma, is formed. This sac replaces a certain amount of bone, and it is the defect in the bone that shows as a dark area in the X-ray picture.

The skull pictured in Figure 23 shows an upper bicuspid with a gold crown (C) on a tooth from which the pulp had been removed. In the bone over the root of the tooth, a hole is seen (H), which has been formed by the granuloma that formerly filled the space. When the bone is covered by gum, this hole cannot be seen.

So slow is the formation of a blind abscess that symptoms are rarely experienced. If an open bone cavity has formed, as in Figure 23, the patient sometimes feels a tenderness when pressure is applied on the gum over the root of the tooth. This, however, cannot be depended upon, as it does not occur unless the outer wall of the

bone has become perforated, a condition very rarely found in the lower jaw. General symptoms, however, are often caused by absorption of pus for which there is no outlet and which, therefore, is taken up by the circulation. This results in general and special diseases, of which more will be said in Chapter VII.

Condition of the Root of the Tooth

The end of the root is in contact with the infection and easily becomes saturated with the products of the inflammation. The cementum that covers it is porous and becomes infested with bacteria. This is an unwholesome condition, of which Nature attempts to rid herself. This is evidenced by the process of absorption, which can be seen at the surface of the root end, and for which there is no treatment of any kind except surgical removal. The dead tooth has to be eliminated before healing of the abscess can take place.

The irritating influence of the infection causes also new formation of cementum near the abscess at the side of the root, where it is healthy. This enlargement near the end of the root makes extraction of the tooth extremely difficult.

Serious Diseases May Result from Caries and Alveolar Abscesses

Neglect or improper treatment may have serious consequences. A condition may start from a simple cavity, pass through the various stages described, and end in extensive disease of the jaws. Any abscess, acute or blind, is in reality an infection of the jaw-bone. Fortunately it is generally limited, but under certain conditions it may develop into infection involving a large part of the bone, or causing lesions known as cysts.

The following case demonstrates what serious trouble may result from a comparatively simple condition. A patient, twenty-six years old, told the following story: In December, 1915, she had had a toothache in the right side of the lower jaw and had consulted a dentist, who examined the tooth and said it needed "capping." After the gold crown was put on, the pain became very much worse, but the patient was assured that it would get better in a few days. The condition, however, grew worse, the face became swollen, the pain was intensified, and the neighboring teeth became tender. She finally became alarmed and consulted another dentist, who extracted the tooth from which the infection had started. From this



FIG. 23. Specimen showing an abscess cavity (H) in the bone of the upper jaw, around the root of the second bicuspid (C), which was a pulpless tooth carrying a gold crown



FIG. 24. Specimen showing two broken-down roots (R) in front of the lower second molar. H indicates the abscess cavity, due to an infection connected with these roots

she experienced only temporary relief, and when the symptoms again grew worse she went to a hospital. When first seen by the writer she complained of pain in the lower jaw and swelling of the face from the chin to the neck. She was unable to open her mouth, and, while her upper teeth were firm, all those in the lower jaw were extremely loose. An X-ray examination revealed that the entire jaw was infected, from one side to the other. The disease was a stubborn case of osteomyelitis, which could have been prevented had the tooth been extracted at the very beginning. As it was, it took ten months to restore the jaw to a normal condition.

The reader can readily see that each of the conditions described in this chapter is a link in a progressive chain, and he can, therefore, realize the tremendous importance of early treatment in dental caries before serious harm is done.

CHAPTER VI

PYORRHEA ALVEOLARIS

“A loose tooth and a feeble friend are equally bad.”

Almost as common as dental caries, and one of the scourges of our time, pyorrhea effects the teeth of man as well as those of certain domesticated animals, such as dogs and cats, which live as pets under our roof. Other names for pyorrhea are Rigg's disease, receding gums, and pericementoclasia, the latter being the latest scientific term. It has been estimated that ninety out of every one hundred persons in the United States suffer from pyorrhea in one form or another.

Dr. Theobald Smith, when experimenting on scurvy, in an endeavor to prove that the disease could be produced by faulty diet, was the first to produce pyorrhea artificially. He found that guinea-pigs fed on oats would in three weeks present all the symptoms of scurvy. The teeth loosened, and the gums became red and swollen, very much as we find them in pyorrhea.

Dr. Percy Howe of Boston has made an elaborate study of the effect of diet on the teeth in animals. He found that certain dental diseases are caused by lack of the substances in the food that are called vitamins. The absence from the diet of one or more of these vitamins, or, as they are more correctly designated by Dr. E. V. McCollum of Johns Hopkins University, Fat-Soluble A and Water-Soluble B and C, will cause so-called "deficiency diseases." The foods which contain them most abundantly are certain fats, leafy vegetables, and fruit-juices. The characteristics of the vitamins and the manner in which they are effected by the processes incident to food preparation will be taken up in the chapter on diet. Dr. Howe found that the animals fed on a scorbutic diet (a diet lacking one group of vitamins, and known to cause scurvy) suffered from pyorrhea. After three days the teeth became loose, and the gums were red and spongy and bled easily. The molars were elongated and in an abnormal position. Infection set in in many of the cases, and other parts of the body showed disease. Some of the animals developed eye diseases and others swollen joints. Some became so lame that they were unwilling to walk. It is interesting to observe that the few animals which received the same diet,

but with the addition of orange-juice, which contains an abundant supply of antiscorbutic vitamins, had none of the symptoms described above.

Constitutional or Underlying Causes

According to the most recent researches, the constitutional or predisposing factor in pyorrhea is that of malnutrition. Errors in diet, and particularly faulty preparation of food resulting in insufficient content of vitamins and mineral salts, play a most important part. Unbalanced diet, faulty elimination, and toxic absorption from intestinal food decomposition resulting from chronic constipation are also important factors. A certain type of pyorrhea is found accompanying other debilitating diseases such as diabetes and mercurial poisoning.

Local or Contributory Causes

The local causes which aggravate the condition causing injury or infection consist principally of unhygienic conditions, such as soft deposits and stagnant food under the gum margin or between the teeth. In his African researches, Dr. Stanley Colyer of London found that along the Upper Zambesi the Barotzi and related tribes suffer a

great deal from pyorrhea, while others are virtually free from the disease. On careful study of the diet it came to light that the Barotzi, Mweru, and Bangweulu natives use as their main food cassava, a root which is dried, crushed, and prepared until it becomes a stodgy, elastic, and rather sticky mass. The natives free from pyorrhea did not possess this food. From these findings Dr. Colyer makes the deduction that pyorrhea is caused by the sticky food remaining around the teeth and irritating the gums. He also believes that modern cooking produces foods of similar consistency which, being gelatinous and adhesive, have a harmful effect when lodged under the gum margin and between the teeth. This theory would also be supported by the fact cited in the first chapter, where it was shown that pyorrhea became rampant among the ancient Greeks and Romans simultaneously with the introduction of elaborate cooking and excessive feasting. Hot and freshly baked bread, cake, and similar foods form a whitish deposit around the teeth, which sticks to the gum margin and cannot be properly removed. Old, dry bread made of coarse flour will not adhere; as a matter of fact, it acts as a cleanser.

Hard concretions on the teeth, such as salivary

calculus, commonly called tartar, also irritate the gum. In addition to this there is serumal calculus, which, deposited underneath the gum and in pyorrhea pockets, forms a secondary source of irritation, contributing much to the chronicity of the disease. Injury of the gums by tooth-picks, injudicious use of the tooth-brush or dental floss, poor filling, inlays, and especially overhanging crowns and ill-fitting bridges are contributory factors.

Uneven position of the teeth, uneven wear, faulty restoration, and many other factors causing excess strain on certain teeth are also very liable to induce pyorrhea.

Early recognition of the symptoms is of greatest importance, because in its early stages the disease can be easily cured. If the gums look bluish red and inflamed, if the small papillæ between the teeth become swollen, or if brushing or using dental floss starts bleeding, no time should be lost in consulting a dentist who treats pyorrhea. Later the tissues become infected (Figure 25), and the disease spreads beneath the gum and attacks the membrane and the alveolar process of the bone which holds the teeth in place. The bone dissolves, leaving a pocket into which the gum

collapses, giving the appearance known as re-ceded gums, exposing part of the root of the tooth. With loss of its bony support, the tooth becomes loosened, and the case must be considered well advanced when the teeth can be rocked with the fingers. All teeth are not affected to the same degree. Some are worse than others, on account of the local contributory causes above mentioned.

The specimen reproduced in Figure 26 shows a case of advanced pyorrhea. Observe that the bone around the teeth has not been equally affected. On the upper incisor (A), the lower cuspid (B), and the first molar (C), the roots are almost entirely exposed. These three teeth were loose. There is considerable calcareous deposit on the roots of the teeth.

So-called "drifting" of the teeth is frequently associated with pyorrhea and generally is found in patients who have lost a number of teeth. The loss of the molars causes the lower front teeth to press against the upper ones during mastication. This makes the upper incisors protrude, spaces appear between the teeth, and the patient's appearance is liable to be impaired. More serious, however, is the constant flow of pus from

the pockets, which not only causes a malodorous breath but contaminates the food.

Systemic Effects

The discharge of pus from the pyorrhea pockets is a constant danger to the patient's health. The infection may spread from the gums to the tonsils, and, by inhalation of moisture, globules laden with bacteria cause laryngitis, bronchitis, and catarrh. The swallowing of quantities of pus, mixed with food, results in digestive disorders. Hunter, the famous English physician, who first called attention to the harmful effects of "oral sepsis," lays stress on the fact that pus from the teeth, when taken into the body with the food, is a cause of ulcers and other diseases of the stomach and intestines.

One patient, whom the writer saw several years ago, had completely broken down with rheumatic fever. He had intermittent attacks of eye disease and had lost a great deal of weight. Examination of his mouth showed inflamed gums. All the teeth were loose, and there were pus pockets discharging freely. X-rays showed that the disease was far advanced and that abscesses had formed at the roots of various teeth. After careful study of the case it was found necessary

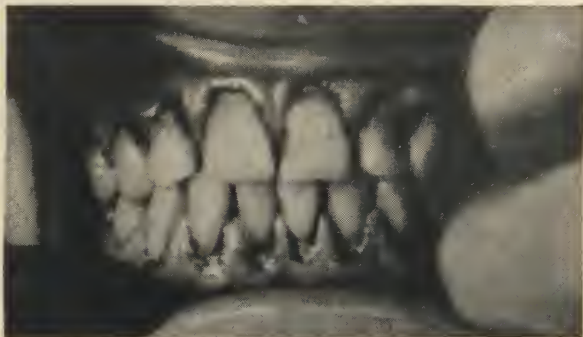


FIG. 25. FRONT TEETH AFFECTED BY PYORRHEA
Observe inflammation of the gums



FIG. 26. SPECIMEN SHOWING CONDITION OF BONE
IN AN ADVANCED CASE OF PYORRHEA

The bone is not equally affected. See text

to extract all the teeth, and this treatment resulted in almost immediate improvement and rapid gain in weight.

Treatment

Early treatment is the secret of a complete cure. If the reader has any suspicious symptoms, he should seek, without delay, the best professional advice. A prominent dentist in the western part of the country, when giving a clinic at a dental convention to show the method which made his treatment of pyorrhea so successful, was reproached with the statement that his cases did not present pyorrhea at all. He replied that this criticism was a proof that most dentists either did not recognize the early stages of pyorrhea or else paid no attention to it until the disease was virtually incurable. When the gums began to bleed and show signs of inflammation, that is the time to begin treatment. In a great many cases this condition of the gums is a symptom of some other disorder of the body, which should be investigated and corrected. The diet of the patient must be carefully studied. Sometimes habits of eating excessive amounts of certain foods, such as meat, sweets, and white bread, have been so firmly established that the patient thinks they are nec-

essary for his welfare. Such food should be replaced by cheese, buttermilk, raw or slightly cooked eggs, uncooked fruit, fresh vegetables, and other foods rich in vitamins, as advised in Chapter XIII. All local contributory causes, such as soft and hard deposits and mechanical irritations, must be removed, the patient's mouth must be put into a hygienic condition, and all artificial work must be so adjusted that there is no cause for irritation and food retention. He must be instructed in the care of the teeth and the home treatment of the gums. The brushing of the teeth as described in the chapter on prophylaxis also stimulates the gums. One should not be alarmed if he makes the gums bleed. Bleeding is a natural cleansing process, and after a few weeks the gums will become so firm that one cannot start bleeding by the use of the tooth-brush. Medicated mouth-washes and tooth-pastes are of great help if used in conjunction with dental treatment and on the advice of the dentist.

A Case of Deficient Diet

A young patient, discouraged because of inflamed and bleeding gums, for which he had received treatment for more than a year without result, consulted the writer, to find out whether

it was possible to do anything more than scaling by the dentist and brushing the teeth and gums at home. His mouth was carefully examined, and it was found that the teeth were clean and well cared for. When questioned as to his diet, he said that he ate a great deal of meat at all meals, including breakfast; he was very fond of sugar and ate candy in large amounts all day. The writer advised him to change his diet, to eat very little meat, not more than twice a week, and to partake of vegetables freely, especially uncooked vegetables. Candy and sugar he was to deny himself, except as used in the preparation of foods, and as a substitute fresh fruit, especially oranges, were recommended. He followed these directions faithfully, and within two months his gums became normal.

In well advanced cases, when a considerable amount of bone has been destroyed, the first step is to find out the exact nature of the condition. This is done by means of X-ray examination, which reveals teeth that are hopelessly involved and discloses irritating conditions under the gum, caused by poor artificial restorations and complications such as abscesses. The treatment consists first of removal of all the teeth that are beyond saving. The fastening of loose teeth with

wires or splints is an unsatisfactory procedure from the point of view of cleanliness. Teeth that are so loose that they need support are a menace to the health and should be extracted. It is also important to know that better artificial substitutes can be made if the teeth are extracted before absorption of the bone around the teeth has gone so far as to destroy the entire alveolar process. Putting the evil moment off for a year or two often means a mouth which cannot be fitted with a comfortable denture, and therefore trouble for the rest of the life. The treatment of the remaining teeth is exactly the same as described for the early stages: the lost teeth should be replaced as soon as possible, and the locking together of the teeth must be so adjusted that the lateral strain during mastication is equally distributed over all the teeth.

Prevention

If pyorrhea is to be avoided, a well regulated mode of living must be persevered in. Soft, starchy, and gelatinous foods, cake, and the like should never be taken between meals nor the last thing at night. They should be followed by food which acts as a cleanser, such as uncooked fruit and foods of a fibrous nature, which are tabulated

in Chapter XIII. Thorough mastication helps by increasing the circulation, which not only furthers the nutrition of the teeth and their investing tissues but also eliminates any waste products which may have accumulated. Cleanliness and hygiene of the mouth are the last but not the least important means of preventing pyorrhea. Many faults that originate from faulty diet can be corrected by carefully brushing the gums and teeth after every meal and thoroughly rinsing the mouth with a mouth-wash as described in the chapter on hygiene.

CHAPTER VII

RELATION OF THE TEETH TO GENERAL HEALTH

“Infected teeth are ill tenants.”

W. Hunter,¹ a celebrated English physician, in an address on “The Rôle of Sepsis and Antisepsis in Medicine,” was the first to call attention to the harm done by what he called “septic dentistry,” which he had observed was responsible for serious ills in many cases. His criticism was at first bitterly resented by the dental profession, but it led to wholesome investigations which revealed that his statement contained a great deal of truth.

Before that time the teeth were treated as though they had no relation to the rest of the body and could not affect the general welfare of the patient. Ten years ago the retention and preservation of the teeth was considered only from the point of view of inefficient mastication and its consequent evil of impaired digestion. The extraction of teeth was, therefore, advised only with great reluctance. The dentist had

¹ London “Lancet,” January 14, 1911.

a guilty feeling when he had to admit that a tooth was beyond his power and skill to save, while his ability to retain, by some device or method, a miserably broken-down root soaked in pus, or a tooth ready to fall out by itself, was a sign of distinction and a token of ability. In the construction of crowns and bridges, the cosmetic and mechanical aspects claimed most of his attention; and the teeth used for support, regardless of their condition, gave him an opportunity of displaying his ingenuity. Thus extensive and expensive restorations were often placed on teeth which were hopelessly diseased and the cause of chronic infections in the jaws. There are many people who have septic conditions under crowns and bridges but are deceived by the usefulness of their dentures.

Investigation Proved Hunter Right

Research work undertaken by eminent bacteriologists, physicians, and dental pathologists, such as Billings, Rosenow, Hartzell, Grieves, and Gilmer, has proved beyond a shadow of doubt that dental infections play an important part in many systemic diseases. The writer's bacteriological and pathological investigations of the infections of the mouth and their relation to general dis-

eases have been published in a book entitled "Oral Abscesses," to which those readers who want more technical knowledge may refer.

The Mayo clinic, world-famous for its high standards and conscientious treatment, requires a thorough investigation of the mouth of every patient. They insist that all dental infections be eliminated and the mouth put in proper condition before any other treatment is undertaken. Dr. Charles Mayo once said that the great mass of people of this generation would not die from one of the great plagues, as they have in times past, but that ninety out of a hundred would probably die because of some simple infection, the result of a focal infection, the focus or original cause of which would give them no trouble.

Other physicians who have a reputation for careful and systematic diagnoses include in every general examination of the body a careful investigation of the condition of the mouth and teeth, and modern hospitals have added to their staff of consultants a dental diagnostician.

Life insurance companies, realizing the dangers which may lie dormant in the mouth and ready to launch a vicious attack when the resistance is lowered, now insist upon an examination of the mouth, including X-rays of the teeth, before con-

sidering an applicant as a fair risk. One way of increasing the possibility for life extension and insuring an old age free from suffering is the removal of dental infection.

The efficiency experts in large industrial establishments employ dentists to examine their employee's teeth and give them advice, while others go a step further and establish dental dispensaries in their factories in order to prevent illness and its consequent loss of time to the concern and to get the highest grade of service from their workers, who can only be expected to give such service when they are in perfect health.

The Phenomenon of Focal Infection

If one has an infection in one part of his body and it is transported from this place to another, the process is spoken of as focal infection. The original site of the disease is called the focus, and the material which is absorbed and which causes the secondary disease is made up of germs and their poisonous products called toxins.

Diseases of the nose and throat, the air sinuses of the face, and the mouth and teeth are probably the most important foci, but less frequent and less considered portals, such as the gall-bladder and genito-urinary tract, should not be overlooked.

Gastro-intestinal infection, food intoxications, and absorption in chronic constipation are other very important factors. All this illustrates the fact that a complete examination should be made in order to best serve the patient. This includes thorough investigation by different specialists who have been trained in their special branches of medicine and a study of the various findings before treatment is decided upon.

Dental Diseases as the Cause of Focal Infection

A diseased pulp in a carious tooth, an infection at the end of a root, involving the bone of the jaws (Figure 23 and 24), and severe cases of pyorrhea are the most frequent dental causes of focal infection. The causes, nature, and symptoms of these afflictions have been described in previous chapters, but it may not be amiss to state here again the fact which puzzles so many patients; that is, that the absence of pain and swelling does not preclude the possibility of a focus of infection in the mouth. One may be harboring in his mouth millions of bacteria without knowing it (see chapter on examination).

Good general health is no guarantee that one has no infection around his teeth, nor that he may forever remain immune to its danger. Every

normal person has a certain amount of so-called general resistance; the fluids and cells of the body bring about a reaction which checks infection and destroys bacteria. Resistance, however, varies in different people and may be less at one time than at another in the same person, and when the resistance is decreased, germs may survive, settle in some part, and cause disease.

Hunger, bad ventilation, lack of exercise, over-exertion, both physical and mental, exposure to cold, acute and chronic disease in other parts, and pregnancy are some of the factors which decrease the general resistance and favor disease. It frequently happens that during pregnancy, when the forces of the body are occupied with special functions, an infected tooth, which has been quiet for years, develops an acute abscess.

Such a case is illustrated by the experience of a patient who had X-rays taken of her teeth several months before consulting me. This examination showed clearly evidence of infection on one of her teeth. Her dentist at that time had advised extraction, but because the condition was latent she refused to lose what she called "a perfectly good tooth." When I saw her she was suffering excruciating pain from this same tooth, the gum around it was inflamed, and her

face was badly swollen. This condition could have been avoided if she had followed the advice given her by her dentist.

Dental Treatment if General Health is Good

So much harm has been done by dental infections that some dentists believe every pulpless tooth is a menace. They believe that no one should retain such a tooth. Others, who have never happened to see a case of remarkable improvement in general health after extraction of infected teeth, are ultra-conservative and still think that a tooth should be saved at any risk, so as not to impair mastication. In my opinion the solution lies somewhere between these two extremes. Although I have often been quoted as radical, I am not one of those who believe in ruthless extraction. There is no reason why pulpless teeth, if properly treated and filled, should not be retained, if the X-ray proves that they are not infected. In younger patients it is also justifiable to treat, by antiseptic measures, teeth with abscesses of very short duration, if the X-ray indicates that conditions are favorable for root-canal work. Teeth, however, which have been diseased for a long time and which the X-ray shows to be necrosed and absorbed should be re-

moved. No one who has studied the tooth and bone pathology of old, pus-soaked teeth, or who has experienced the odor from one which has been removed, would ever hesitate, or have any doubt as to what should be done. In such cases I believe in radical measures. Nature itself shows its abhorrence of a tooth which has become an obnoxious foreign body. The absorption at the end of the root indicates a process of elimination which should be hastened by extraction of the tooth. This is necessary from a purely dental point of view, or even for the sake of cleanliness.

Patients are often bewildered by the opposing views and advice which they receive. Unfortunately, no hard and fast rules can be given. It is a matter of judgment and opinion, based upon careful analysis, into which must enter a thorough knowledge of pathology, and experience gained by observation of large numbers of such cases. The patient should seek the advice of a dental diagnostician who is qualified for this work.

Dental Treatment if General Health is Affected

In patients suffering from systemic disease, which is known to be caused by focal infection, the question arises whether the dental infection is the original cause or whether the two condi-

tions are not related to each other. Such a question must be answered individually. McCrudden writes that "in chronic disease, the hopeful therapeutic measure lies in improving the functional efficiency of the body and in improving the general health."¹ To further this achievement it is important to remove all infectious tissue, because the organs whose function it is to combat disease must be freed from any additional burden. The patient, therefore, will benefit by the elimination of dental disease, even though the condition in the mouth is not the direct cause of the trouble. This applies especially to heart-disease, the treatment of which requires that anything taxing the function of the heart be eliminated. In such cases conservative treatment of diseased teeth is not advisable because, in addition to the reasons just stated, in patients with lowered resistance it is always doubtful whether the treatment of infection will be successful. I know of patients who were advised, without even an X-ray diagnosis, to have all their teeth removed, when further examination revealed a number of vital teeth that were very useful in re-

¹ F. H. McCrudden, "The Treatment of Chronic Diseases Is a Problem of Applied Physiology," "Boston Medical and Surgical Journal," Vol. CLXXV, No. 2.

construction work. Such ruthless extraction is inexcusable.

The patient's interest naturally centers around the question of how much benefit he will derive from the removal of infected teeth, but this is difficult to forecast. Positive statements are seldom justifiable and sometimes lead to disappointment, especially if made by an enthusiast who has no intimate knowledge of the medical aspect of the case. A patient who was suffering with pain in his foot once came to me for extraction of a number of teeth because he had heard that rheumatism could be cured by extracting teeth. I had a hard time to convince him that his teeth were all right. The specialist to whom I referred him reported that he had fallen arches.

The fact that some people do not improve after a focus of infection has been eliminated may be explained by the presence of another focus existing elsewhere, such as in the nasal sinuses or the gastro-intestinal tract. Another reason is that often the secondary disease is of long standing and is so firmly established, or the tissues so extensively destroyed, that very little can be hoped for by removing the focus. It is not unlike the stoppage of a leak in the plumbing, which may have caused a wet spot on a ceiling. Even if the

spot dries, it leaves a mark, which requires further repair. It is necessary to resort to special treatment to eliminate the secondary disease; but in the patient, as well as in our example of the leak, one important thing has been accomplished: the cause of the trouble has been removed, and we are safe from it in the future. This also teaches the value of extracting infected teeth before any harm has been done in other parts of the body.

How Dental Disease May Affect the Rest of the Body

There is more than one road from bad teeth to ill health, and the rest of the chapter will be devoted to a description of the principal methods by which dental infections may affect the rest of the body.

Neglected mouths, with decayed and broken-down teeth containing decomposed food, red and congested gums, and pyorrhea pockets furnish great opportunities for the incubation and development of bacteria. It is no wonder that communicable diseases are rampant among children with unhygienic mouths. Neglect of parents to take care of their children's mouths before they start to school causes the greatest harm in this respect. Dr. A. C. Fones, who has intro-

duced mouth hygiene into the schools of Bridgeport, Connecticut, gives some interesting statistics of three diseases common among school-children. The figures give the death rates per 100,000 population in 1914, before introducing mouth hygiene, and in 1918, after it had been established four years.

	1914	1918
Diphtheria	36.6	18.7
Measles	20.	4.1
Scarlet fever	14.1	0.5

This is a reduction of these three diseases from 24.6 to 7.8 per 100,000 population.

While the Government is endeavoring to enforce its pure-food laws, quantities of food are being spoiled in the mouths of the consumers. With this thought in mind it is interesting to recall what tremendous efforts are made to examine cattle, certify milk, inspect meat and other food-stuffs, and furnish pure water, and the enormous amount of money spent for this purpose. New York City alone spends about one hundred thousand dollars annually for food inspection. All this is of no avail when the things we eat and

drink are mixed, before they reach the stomach, with decayed food and pus oozing from the gums and teeth.

If one's food seems to have lost its flavor so that one does not enjoy eating, it may be due to septic conditions in the mouth. The taste-buds cannot perform their duty if they are constantly filled with unhealthy secretions, such as pus, coming from pyorrhea pockets and fistulæ, or with decomposed food decaying in broken-down teeth, so that whatever is eaten tastes like everything else.

Deficient Teeth and Insufficient Mastication

It is evident that mastication cannot be properly performed unless all the bicuspid and molars are present. Needless to say, the loss of teeth decreases the efficiency of mastication. There are, however, other conditions which lead to insufficient mastication. Malocclusion sometimes prevents proper motion of the jaws, and bridges, or other artificial appliances, if not properly constructed, may be a hindrance instead of a help to mastication. In children, deep cavities or infected teeth cause a painful sensation when grinding food, with the result that the child bolts his food unmasticated. Insufficient mastication is

frequently the cause of indigestion, since food not sufficiently broken up does not offer enough surface for the action of the digestive juices. Starchy food, especially, should be thoroughly masticated, as it depends upon mixture with a large quantity of alkaline saliva for favorable digestion. Dyspepsia is frequently caused by bolting the food.

The Effects of Swallowed Pus on the Digestive System

If one were asked to take half a spoonful of decayed food and pus with every meal would he expect to remain healthy? This is exactly what happens in children suffering from dental caries and gum-boils, because of broken down temporary teeth, and in the mouths of adults who have pyorrhea, sinuses from infected teeth, or ill-fitting crowns and bridges, which often cause most unsanitary conditions and are a source of gingival inflammation and ulceration. Many can withstand the ingestion of this pus for a long time, but the day of reckoning is sure to come. For a long time the acids of the stomach have been regarded as destructive to bacteria. Hunter, however, says that there is a limit to the power of the stomach to destroy micro-organisms

and that these powers become progressively weakened. Eventually disease of the stomach results, and the infection may also be carried to still more remote parts of the intestinal canal.

A patient consulted Dr. Hunter once for severe intermittent sickness and pain in the stomach, which had been causing trouble for eight months. There was loss of weight, increasing weakness, and other symptoms suggesting cancer. Morphia had to be used, and constant complaint was made of a bitter taste in the mouth, nausea, and loathing of all food. The tongue was coated with a dirty, moist fur. The patient wore false teeth, both in the upper and lower jaws. The plates were scrupulously clean and the gums beneath healthy. Of the four teeth present three were decayed, suppurating around the roots, with pus welling up on pressure. On examination Dr. Hunter found no sign of malignant disease in the stomach or abdomen, and he made a provisional diagnosis of gastritis (inflammation of the stomach), caused by continual swallowing of pus. He ordered the removal of the teeth. A week later the patient's tongue was clean, and his sense of taste had returned for the first time in eight months. The condition of the stomach improved, but was not cured at once. The vomitus obtained



FIG. 27. SPECIMEN SHOWING THE RELATION OF THE TEETH TO THE MAXILLARY SINUS

The outer plate of bone has been removed to show the roots of the teeth extending into the sinus cavity (A). Observe that very little bone covers the ends of the roots

two weeks later was still found to be loaded with bacteria. Treatment of the stomach was necessary in addition to removal of the dental cause, after which there was complete cessation of all pain and a steady recovery, with increase in weight, from that time onward.

Dental Diseases as Related to Diseases of the Nose and Throat

Dental diseases are frequently related to diseases of the nose and throat. We have already seen in a previous chapter that narrow dental arches may be the cause of insufficient lateral development of the nasal passages, which invites the formation of adenoids. Pus from the teeth, on the other hand, when discharging into the mouth, often causes infection of the crypts of the throat, the tonsils, and passages leading to the ears (Eustachian tubes).

The air-chambers, called maxillary sinuses, in the cheek-bone on either side of the face, are intimately related to the teeth, as illustrated in Figure 27. When an infection begins on the end of the root of a tooth it easily spreads to the mucous membrane lining the sinus cavity. This may result in an acute inflammation, with the following symptoms: fullness in the affected side of the

face, pain, and purulent discharge from the nose. More frequently, however, we get a chronic process of degeneration, which goes on without the patient's knowledge, and the slight amount of pus is absorbed by the system.

To illustrate the danger of an infected tooth and the spreading of the disease to the maxillary sinus, let me cite the case of a patient who came to me with the following history: About six months before, he had felt a pain in the right side of the upper jaw, and the first molar was tender when he bit anything hard. He bought some toothache drops in a drug-store, and after a few days was relieved. He was advised to consult a dentist, but as the pain did not return he thought it was not necessary. Two days before I saw him, however, he woke up with a dull pain and heavy sensation in the right side of the face, and the next morning he found a considerable amount of pus coming from the right nostril. Remembering the trouble he had had with the tooth, he made an appointment for an examination. X-rays revealed an abscess area on the tooth, extending into the maxillary sinus, and a picture taken of the entire face showed clearly that the neglected infection had involved the maxillary sinus.

Every one who suffers from maxillary sinus disease should have an X-ray examination made of his teeth and, on the other hand, when infected teeth are found in the back part of the upper jaw, it is advisable to have the sinuses investigated by a competent nose and throat specialist and by the X-ray method.

That a tooth which is only slightly abnormal from an X-ray point of view is a danger point from which infection may spread, causing serious disease of the maxillary sinus, is exemplified in my own experience. When my upper first bicuspid was prepared for a filling years ago, the pulp was accidentally exposed and had to be removed. The dentist treated and filled the root-canal to the best of his ability and according to the best methods then in use. About three years ago I had an X-ray taken of the tooth, which was found to be in close relation to the maxillary sinus. A slight area was discovered around the end of the root, so slight that I decided to retain the tooth, on the chance of its giving no trouble. One morning, however, I awoke with a throbbing sensation and a fullness in the side of the face where the tooth was. On leaning over, there was a slight discharge from the nose. I consulted a nose specialist and had an X-ray taken. My

suspicion that the tooth had infected the maxillary sinus was confirmed. On account of immediate recognition of the nature of the disease and prompt removal of the cause by extraction of the tooth, the sinus soon became normal again and has remained so ever since.

If the reader has never had any trouble with the maxillary sinuses, he may not know where or what they are, but if he realizes that in more than 60 per cent. of the cases the underlying cause is an infected tooth he will appreciate the importance of taking no chances with infected teeth which extend into the maxillary sinuses, especially when he considers the seriousness of the disease and the difficulties of treating and curing cases of long standing.

How the Teeth Affect the Ears

The nerves of the teeth, both in the upper and lower jaws, are connected with those of the ears, and it is not at all uncommon for pain from some dental cause to be referred to the ear. The patient then supposes that he is suffering from some aural disease, but examination of the ears shows them to be absolutely normal. After a careful dental examination we generally find a diseased pulp, an infection at the end of a root,

or an impacted tooth, causing pressure (see Chapter IV, pain in the ears caused by impacted teeth).

A patient suffering from earache or otalgia was referred to me by a friend who had had a similar experience. She had consulted an ear specialist, but he could not find any cause for her symptoms, the ear being entirely normal. I took X-rays of her teeth and discovered a lower second bicuspid on the affected side with an obscure cavity under the gum. There was evidence of infection at the end of the root, and apparently the pulp was diseased. The tooth, however, had never given the slightest trouble. After it was extracted the earache was entirely relieved.

Micro-organisms from septic conditions in the mouth may travel to the back part of the nose and throat and pass through the Eustachian tubes to the ear. Besides this path, there are the blood and lymph channels through which bacteria may cause an infection of the middle ear.

A patient who had suffered from repeated attacks of middle-ear infection, with a great deal of discharge from the ear and pain which would not subside, was advised by her physician to have her teeth examined. When she consulted me I made a complete X-ray examination of her teeth

and found in the upper jaw on the affected side evidence of extensive infection on a bicuspid and molar. The third molar was found to be impacted, and the gum around it was highly inflamed, with a sinus discharging pus. I advised removal of all three teeth under local anesthesia, and after I had injected the nerves supplying these teeth the pain in the ear stopped at once. The treatment of the dental condition was followed by rapid improvement, and after a short time the patient was entirely relieved of her ear trouble.

Involvement of the Lymph-Glands

The lymph-glands which drain the teeth and tissues of the mouth are situated behind the chin, inside the angle of the jaw. When pus and bacteria are absorbed by the lymphatic vessels they reach these glands, which are sometimes compared with filters. The net chain of glands, which form a second line of defense, are located on the side of the neck.

In the performance of their duty, the lymph-glands, which ordinarily are so small that they are not noticed, become enlarged. They may be either elastic, soft, and tender to the touch, or, in infections of longer standing, hard, large, and

prominent. Enlarged lymph-glands are most common in children, but they frequently occur in adults.

A student consulted me on account of a round, movable swelling underneath his jaw, which was tender. Examination showed that what appeared to be a swelling was in reality an enlarged lymph-gland. He complained of no pain from his teeth and when looking them over I could find nothing that seemed abnormal. X-ray pictures, however, showed evidence of disease on the roots of the lower second molar, apparently caused by an infection, which was transmitted through the pulp from decay under a filling. When I opened into the pulp I found it putrescent, and after proper treatment the lymph-glands became normal in a very short time.

Absorption from Dental Infection

Pus absorption in acute dental infection does not differ from the absorption of acute infections from other parts of the body. It is the cause of the so-called constitutional defects. These are evidenced by fever, quickening of the pulse and respiration, hot, dry skin, constipation, highly colored urine, and, later, sweating and, perhaps, delirium at night. In serious cases, when the ab-

sorbed bacteria grow in the blood, we get septicemia, popularly called blood-poisoning.

In chronic infection pus absorption takes place only on a small scale, and, therefore, there are no sudden and alarming symptoms. This causes a great many people to underestimate its dangers. The fact that in most instances there is no pain or swelling is the reason for the infection remaining unnoticed for years, sometimes until the general health is irreparably undermined.

The Result of Absorption of Pus and Bacteria

The most common result of septic conditions in the mouth, such as pyorrhea, or infection at the roots of devitalized teeth, is a so-called chronic toxemia, which manifests itself by all kinds of vague symptoms caused by the action of the absorbed bacteria, or the poisons they form, or both, on other tissues or organs in any part of the body. It is true that a perfectly healthy person may be able to eliminate the daily dose that is absorbed, as he may eliminate a certain amount of alcohol or nicotine, but at some time or other conditions may arise which bring about grave results.

Disproportionate fatigue from slight exertion, a constant tired feeling, the inability to do an

ordinary day's work, both mentally and physically, are common manifestations of chronic toxemia. A frequent accompaniment of these symptoms are dry, sallow, or grayish skin, loss of appetite, headaches and constipation, and often the patient loses weight and requires an abnormal amount of sleep. More rarely there is a rise of temperature in the afternoon or evening. Generally the patient is not really sick and often thinks that a tonic or a rest and change of climate will give relief, only to find that the benefits from this treatment are but temporary. A cure cannot be effected without removal of the cause of the condition.

A number of years ago, when we had just began to realize the importance of dental infection, a patient presented the following conditions: He was a middle-aged man who had always been in the best of health. Recently, however, he complained of a feeling of grogginess on rising and other symptoms which manifested themselves in benumbed mental activity. Smoking made him ill, whereas he had been able to smoke a great deal before. He also complained of chronic constipation. He had consulted two physicians, who could find nothing radically wrong with him, but an examination of the teeth revealed infection

of the bone around the roots of three teeth. I first attempted to treat these teeth through the root-canals, which when opened gave out a vile odor. The patient improved during the treatment, but a few weeks after the root-canals were filled the same symptoms returned. I then undertook more radical measures, and after all the diseased tissue was surgically removed the patient got permanent relief, his mind became again keen and alert, and his other symptoms disappeared and have not returned in the six years that have elapsed since.

Another patient, a young girl, came to see me about a tooth that had been treated for several weeks without success. She had no discomfort in her mouth, but complained of a constant tired feeling and intermittent fever of about eight months' standing. After X-ray examination, which showed evidence of a large abscess at the end of the root, I advised extraction of the tooth. When this was done the patient improved rapidly, and her fever did not recur.

Also complaining of a constant tired feeling and headaches that came on in the morning once or twice a week, a patient once consulted me, believing that the condition was due to the teeth. X-ray examinations showed four pulpless teeth,

three of which were without infection, but one showed a very small area at the end of the root. I advised a thorough physical examination before considering extraction of the teeth. She took my advice, and her physician found that she had some intestinal trouble which he thought caused her symptoms. When this condition was remedied she became perfectly well.

Tuberculosis Suspected

Another patient, a man about eighty years old, who had formerly enjoyed good health, suddenly developed a temperature, running about ninety-nine degrees during the day and up to one hundred at night. It was accompanied by lassitude and lack of appetite. He was examined by a careful physician who could find no disease, but on account of the fever he thought there might be a slight tubercular process present. X-rays of the lungs, however, showed that this was not the case. He continued to suffer from this condition for two months, when X-rays were made of his teeth. The pictures revealed three large abscesses. I did not give the patient too much hope of relief from his general symptoms, but advised extraction of the three teeth on principle. The result of this treatment, however, was very

gratifying. The temperature became normal within two days; the patient rapidly improved and has remained well ever since (two years).

Septic anemia is a disease of the blood characterized by sallow complexion, loss of bodily and mental vigor, and loss of weight. A change in certain constituents of the blood takes place. Hunter classifies under this head all cases of anemia that are due to infection, the cause of which he says is generally found to be disease in the nasal cavity, the nasal sinuses, the teeth, or intestinal tract. He described several cases of this type. Here is a case from the writer's practice.

The patient, a very active and prominent man from one of the Southern cities, gave a history of having been unusually well until about a year before, when he broke down after a severe attack of grippe, the symptoms being principally those of a nervous collapse. His physician sent him away for a rest, and after two months he was somewhat improved and returned to work. Soon, however, he was again obliged to give up his duties, and, after another medical examination, he went to the mountains for a month. Here he became very anemic and had some other disquieting symptoms. When he consulted a phy-

sician in Boston an X-ray examination of his jaws and teeth was advised. The pictures revealed a large cyst in the lower jaw, caused, as the plates showed, by a root that had been left after extraction of a tooth many years before. An operation for removal of the cyst was performed, and the root was removed at the same time. A large amount of pus was released. The patient improved rapidly and soon went back to work. Although he had a great many extra activities during the war, which began soon afterward, he remained perfectly well and has been so ever since (six years).

Mental Diseases

Dr. Henry A. Cotton, medical director of the New Jersey State Hospital of Trenton, presented to the medical profession the results of his extended study and observations, asserting that a certain percentage of nervous and mental diseases are the results of toxemia caused by chronic focal infection. From his work he deduced that the removal of infected teeth and tonsils and the clearing up of infection in the stomach, intestines, and other vital parts of the body had resulted in remarkable recoveries of insane patients. An article in the "Review of Reviews" for April,

1922, written by the state commissioner of institutions of New Jersey, describes the work at Trenton in an interesting manner. The insane asylum has been transformed into a hospital. All restraining apparatus has been eliminated, and the place has been freed of those terrors, partly real and partly imaginary, that torment the minds of the insane. The patients are treated just as any other sick person is, and a careful, systematic survey, aided by well equipped clinical and X-ray laboratories, is made in every case. A number of cases were reported by Dr. Cotton in the "Journal of Dental Research," and all of these undoubtedly were relieved of the symptoms of insanity."¹

The Rheumatic Group of Diseases

There is no question that certain conditions often spoken of as "rheumatic" are due to focal infection and are frequently caused by dental diseases. Among these belong certain arthritic conditions, such as cause swelling and pain of the joints, neuritis in various parts of the body, and secondary infections of the eyes and ears.

A patient suffering from a severe attack of lumbago was sent to me for examination of the

¹ "Journal of Dental Research," 1919, p. 269.

teeth, with the idea of discovering any possible infection in the mouth which might account for her trouble. All other causes had been ruled out by her physician. The X-rays showed a large area on a lower molar, indicating an abscess at the end of the root. This was one of the chronic type, causing no pain or local disturbance of any kind. I extracted the tooth, and the patient reported that she was relieved promptly and that her back had been well ever since.

Another case is that of a patient who had such pain in his back and shoulders that he was incapacitated for work and had to give up his place as a chauffeur. A careful physical examination showed no cause for his trouble, and X-rays of his back revealed no changes in the bones. The condition was thought to be due to focal infection. When he was referred to me I took X-rays of his teeth, several of which showed evidence of infection. As there was no other infection found in the body, the extraction of these teeth was decided upon. The result of this treatment was rapid improvement, so that he was soon able to go to work again. He is now driving a truck and has been free from the symptoms he had complained of.

In a consultation with another patient, he stated

that five years before he had had a sudden attack of rheumatic swelling and pain in the knees. The shoulders were next involved, and in a short time all the joints were painful and inflamed. The patient had taken electric baths, but they had not given him any relief. At the time of my examination he was in great pain from his joints and had to walk on crutches. He had no pain in his teeth or face, but an X-ray examination showed that one of his upper molars was diseased and had caused a chronic infection of the maxillary sinus. Extraction of the tooth and treatment of the sinus resulted in general improvement, and after seven weeks he was entirely rid of his rheumatic symptoms and could walk without assistance.

Summary

The movement that began about two decades ago to save every tooth at all costs, and the practice of removing the pulps of teeth for the purpose of attaching bridges or improving their appearance by cutting them off and attaching porcelain crowns, are greatly to blame for the fact that so many people to-day suffer from chronic dental infection. Before that time, teeth were promptly removed on the slightest provoca-

tion. This was a great safeguard against septic absorption from dental disease, but frequently teeth were extracted, not because they could not be filled, but because it was simpler to make an entire artificial set. The value of the teeth was greatly underestimated.

To-day physicians and patients have begun to realize the importance of the teeth, both in health and disease. The cases enumerated in this chapter have been selected, not to give the impression that all ills come from diseased teeth and can be cured by ruthless extraction, but to emphasize the important relation of dental diseases to the general health, and for the purpose of arousing the layman to timely treatment. When the patient's general health has become involved it is generally too late for conservatism and preventive treatment, and the existing conditions usually demand extraction of the infected teeth, if only for the sake of hygiene. Preservation of the teeth starts at an earlier age. The lamentable fact that so many people have to lose some of their teeth before they reach middle life discloses the need for preventive dentistry and a better understanding of the benefits that may be derived from oral hygiene and proper diet.

CHAPTER VIII

SUBSTITUTES FOR LOST TEETH

“A mouth without teeth is like a mill without a stone.”

The loss of even one tooth will often cause a disturbance in the proper locking together of the teeth, breaking up the contact of the dental arch. Teeth which have lost their lateral support will tip, and if they have lost their opposing teeth in the other jaw they will gradually work out of the socket.

The loss of teeth also frequently changes the facial expression. If there are large spaces in the dental arch the teeth may tilt, and if the support of the back teeth becomes insufficient the jaws close, bringing the chin and nose in closer relationship. This changes the proportions of the face and may cause abnormal folds or wrinkles about the mouth, giving an expression of age and dejection.

The efficiency of mastication is decreased by the loss of teeth, but many people are not aware of this fact, and it is surprising how they sometimes get along without missing their back teeth

and without properly masticating their food. The onset of digestive troubles may cause them to reflect.

To avoid the ultimate loss of good teeth, prevent digestive disturbances, and ward off certain disfiguring changes in facial expression, all the spaces where teeth have been lost must be filled in as soon as possible, the only exceptions being the wisdom-teeth. There are different ways of replacing teeth, but the most important are fixed bridges, removable bridges, and plates. Each type has its advantages and disadvantages, and after studying the mouth the competent dentist will recommend the type which he thinks best suited. A great deal of confusion in this respect is caused by well intentioned friends, who give advice from the depths of their own experience without knowing anything about the particular conditions in the mouth. A description of the advantages, and disadvantages of the different types of substitutes should, therefore, give the reader a general idea of their most important characteristics; but he should remember that in each case a careful study is necessary, and a selection must be made with consideration not only to the desires of the patient but of the various conditions in the mouth.

Surveying the Mouth

When several teeth have been lost and substitutes are to be planned, it is necessary to consider the mouth as a whole if harmonious results are to be obtained, even though all the work is not to be done at one time. For this purpose the dentist should make plaster models of the teeth and from these models study the case from every angle. A complete examination of the teeth is always advisable, to detect infected and diseased teeth, the extraction of which might entirely upset the plans for restoration. For example, let us consider the case of a patient who has lost two teeth on the left side of the lower jaw. On each side of the space is a good tooth to which a sanitary fixed bridge could be attached. All the teeth on the right side except the wisdom-tooth are present. Before beginning the bridge, X-ray examination of the teeth on the right side discloses the fact that two molars and one bicuspid are infected at the ends of the roots. The condition is such that extraction is necessary. This will leave no teeth on the right side posterior to the first bicuspid. Considering the case with these new facts in mind, a removable bridge or partial plate would be very much better suited to this particular case, since

it would replace the teeth on both sides and is the only means of replacing those on the left side.

The Fixed Bridge

The fixed bridge is firmly cemented to the teeth on either side of the space from which the teeth are missing. It simulates the natural condition more closely than any other substitutes. Although a great deal may be said for removable dentures, the fixed bridge, if properly constructed, is still the most desirable means of replacing lost teeth. Fixed bridges, however, have been severely criticized on account of the unhygienic conditions frequently found under them. This, however, may be due to the fact that the patient does not take proper care of the appliance. The wearer of a fixed bridge should be instructed in the care and cleaning of it (see chapter on hygiene). Irritation of the gums and pus pockets are often due to poorly fitting gold crowns and poor methods of construction. Fixed bridges must be so made that no injury of the tissues occurs, and they must not interfere with the hygienic condition of the mouth and must be easy to clean by means of special brushes and dental floss. There are various ways of attaching them to the supporting teeth, the best being those which

require the least tooth destruction. The removal of the dental pulp for the sake of a better attachment is seldom justified, as it may cause loss of the tooth.

Removable Bridges

From the sanitary point of view, removable bridges are ideal since they can be taken out and cleaned and the teeth to which they are attached thoroughly brushed. There are several different methods of attaching them to the teeth, and with some of these it is not necessary to destroy any of the tooth substance. Experience has proved, however, that all attachments that cause friction on the anchoring teeth, no matter how well the denture is constructed, will in some mouths cause erosion. The fact that the bridge can be removed is sometimes a disadvantage. Patients often come into the dentist's office complaining that the denture does not fit satisfactorily, and when the matter is investigated it is generally found that instead of wearing it the patient leaves it most of the time reposing in a dressing-table drawer or a waistcoat pocket. The teeth change their relations if the bridge is not worn every day, and in a comparatively short time these changes pre-

vent the denture from fitting properly. Generally it is better to wear it at night also.

Dentures

The replacement of a large number of teeth necessitates the wearing of a plate. In the upper jaw full dentures, those supplying all the teeth, are often more satisfactory than partial ones, because if two or three teeth remain and the plate is built around them the suction by means of which upper plates are held in the mouth is rendered less efficient. In the lower jaw, on the other hand, it is a great advantage to be able to save two or more teeth to give the plate support. People with pyorrhea who lose teeth are particularly hard to fit with artificial dentures because the disease destroys the alveolar bone which is the principal support of the plate. Most people do not know this and wait as long as possible before having the teeth extracted, with the result that the mouth is in such a condition that it can never be fitted with a comfortable denture. There are many different ways of constructing a plate. It may be made of rubber, of aluminum, or gold, and when a particularly artistic effect is desired, platinum may be used with hand-carved

teeth and porcelain gum. Gold, aluminum, and platinum, being less porous than rubber, are not so easily affected by the fluids of the mouth and are therefore less liable to irritate the tissues of the mouth.

Dental Crutches

Some people neglect their teeth and think that some day they will have them all extracted, believing that this will save trouble and expense. They do not realize that the best possible substitutes are never equal to their own teeth and that if they happen to have a poorly formed mouth no really comfortable denture can ever be made. Although a few patients say they prefer their artificial teeth to their own, as a rule the artificial denture is a compromise. With all the conditions favorable and the workmanship perfect, it has been estimated that the average person wearing a full upper and lower plate has only about 40 per cent. of his original biting and masticating ability.

The success of artificial dentures depends in large measure on the mental attitude of the patient, besides the shape and form of the mouth. Every case is different. Some people are fortunate enough to have mouths which would hold up

the crudest plate, while others find the most up-to-date and carefully made dentures only partially satisfactory. When a denture is first inserted it seems so large that no room is left. This feeling disappears within a few days if the patient is willing to do his share by wearing the denture constantly. If sore spots appear on the gums, it means that the denture needs adjustment. As time goes on and the places where the teeth were extracted heal, a certain amount of shrinkage of the gums may ensue. This means that the plate must be relined or remade. The question of being able to eat with new dentures depends upon mechanically correct construction, but in all instances the patient must learn to masticate with them, and after some practice and perseverance their proper use will be acquired.

CHAPTER IX

PAIN : ITS MEANING, CAUSE, CONTROL, AND TREATMENT

“He jests at pain who never felt a toothache.”

Pain is a monitor which warns the conscious mind that there has been neglect and abuse which will undermine and impair the structure and functions of organs unless immediately attended to. It is primarily a protective device, giving information as to conditions affecting the normal state of the body. In this capacity it is a friend, but when operative measures become necessary to correct abnormal conditions pain is a hindrance and it is necessary to take steps to control it. In disease, pain is to be regarded as a symptom, and the treatment for relief must be directed toward the cause of the disease. Closely related to the physical manifestations of pain is fear, an emotion which is deeply rooted and has strong reactions on the functions of the body. Fear can only be controlled by psychological influences.

Race, age, sex, general health, and susceptibility of certain individuals are factors which ex-

plain differences in the intensity of pain. The promotion of self-control, such as was practised by the ancient Spartans and the American Indians, tends to minimize both the mental and physical aspects of pain, while such emotions as worry, fear, fright, and dread may cause an enormous exaggeration of the actual sensation.

The intensity of pain also varies according to the part of the body affected, some parts being much more sensitive than others. In the mouth the nature of pain varies greatly.

As has been already stated, pain from disease is a blessing in disguise. One should not try to cure a toothache by means of toothache drops or other palliative methods, but should see a dentist at once and get at the cause of the trouble. There are pains that are due to chemical action, such as the influence of sugar, salt, or acid food, and these indicate that there is a cavity somewhere in the tooth, although they may also be caused by exposure of the sensitive surface of the root when the gum shrinks from the tooth. When the pulp of the tooth becomes involved there is, first, pain from cold; later, hot things cause increased pain, which is relieved by cold; but when the pain is intensified by pressure, percussion, or other mechanical influences it is a sign that

the infection has spread beyond the tooth and that an acute abscess is beginning to form. Such toothaches may be sharp or dull, lancinating, continuous, intermittent, localized, or diffuse. The character of the pain is often so typical that it helps the dentist to discover the seat of the trouble.

Chronic infections, such as we have studied in Chapter V, generally develop without transmitting any danger-signals. This entire absence of pain is the reason extensive harm has been done when the condition is finally discovered.

Referred Pain

Pain in one tooth may be referred to another or even to other parts of the head, and it is then frequently spoken of as neuralgia. Pain in the forehead, the back of the head, the nose, the eye, and the ear may be due to any one of a large number of dental conditions. The discovery of the cause is often very difficult and requires not only a careful study of the history and symptoms but also X-rays of the teeth and entire face.

One of many such cases that I have seen was that of a young woman who had been suffering from earache and what she called "face-ache" on the right side. She consulted an ear specialist, who

examined her carefully but found her ears entirely normal. She was referred to me, although she thought at first that it could not possibly be due to her teeth, as she had had them examined very recently. I took X-rays and found a large cavity in a lower bicuspid, underneath an amalgam filling, entirely hidden by the gum. The picture also showed evidence of infection at the root of the tooth, indicating that the decay had reached the pulp and caused a chronic infection. Extraction of the tooth promptly relieved all her symptoms.

Operative Pain

Operative pain is the pain one thinks of when dentists or dentistry is mentioned. "Will it hurt?" is the question most frequently asked in the dental chair, and "Does he hurt?" is the inquiry made in confidence to a friend when the ability of a new dentist is being discussed. This, however, is a poor standard by which to judge a dentist, and in general one can suspect that the saving of pain may be at the expense of the quality of the work. On the other hand, a dentist is very often not to blame for poor work. It may be entirely the fault of the patient, who is not willing or able to submit to the discomfort necessary for proper performance of the operation.

The patient's attitude is of great importance. Here comes Mrs. Touchy, who is five minutes late for her appointment because she has been shopping all morning. She is very much put out because the attendant tells her that she will have to wait a few minutes, the dentist being engaged in finishing a delicate operation that happened to require a little more time than he had expected. "The idea!" she says. "My appointment was for twelve o'clock. It is now seven minutes past, and I don't see why I cannot be seen promptly." When she finally sits down in the dental chair, the head-rest is first too high, then too low, then a little too far back. She has a baretté in her hair which presses into her scalp and makes her uncomfortable during the entire sitting, and she is sorry she did not go to her friend's dentist, who has a very fine chair. The dentist has a painful operation to perform and advises the use of a local anesthetic, but the patient just hates the idea of it: "These dentists just enjoy sticking a needle into you when it is not at all necessary." The dentist tries to make the best of it, but the tooth is hypersensitive, and the patient cannot see why he must constantly touch the place that hurts. The dentist in Skowhegan, where she used to live, had a very much better way of doing it.

When the sitting is finally over the dentist and the patient are completely used up, and the result of the work is a compromise.

Another patient, although highly sensitive, realizing what can be accomplished, arranges matters so that she is well and rested at the hour of the appointment. She allows plenty of time, so that she can sit down a few minutes before being asked into the dentist's office. Her mind is in a calm and coöperative mood, and she tries her best to relax. She has perfect confidence and realizes that if the dentist tells her he must hurt a little he does it because it is necessary and not to satisfy his "professional craving to inflict pain." Any dentist is happy to serve such a patient because it gives him the opportunity to apply his greatest skill.

Operative Pain can be Controlled

To-day we have efficient methods of controlling pain successfully. When a sensitive cavity needs to be excavated, or a tooth ground, when an aching pulp must be removed, a tooth extracted, or any surgical operation performed on the jaws, it can be done in a painless manner. Nitrous oxide and oxygen gases were first used for this purpose and are still employed with good effect. The patient

can be put into a semi-conscious or entirely unconscious condition, so that he does not mind, or does not know anything about the pain. Perfection of the method of injecting novocain, or procain, as it is also called, has made local anesthesia the most popular method of eliminating pain from dental and oral surgical operations. The solution can be injected directly into main-nerves, making it possible to operate on a large section of the mouth or to extract a number of adjoining teeth painlessly. It has the advantage, which is especially important in filling teeth and the like, that the patient is fully conscious and, therefore, can coöperate in every way. Furthermore, the anesthesia last more than an hour, which is sufficient time for the ordinary dental operation. Novocain when administered by an expert, gives excellent results, pain is entirely eliminated, and there are no after effects, such as soreness and sloughing. Failures in administration of this anesthetic are generally due to not reaching the nerve, and not to the fact that the drug does not take effect on the patient. Patients sometimes think that pain after extraction is caused by the local anesthetic, while as a matter of fact it is entirely due to the operation, as will be seen in

the next paragraph. The action of procain is solely local, unless accidentally injected into a blood-vessel. It can be used with safety in pregnancy and nursing.

Pain after Operations

Injury to the bone and soft tissues incidental to the operation, such as a difficult extraction of an infected tooth, causes pain, which is felt just as soon as the effects of the anesthetic wears off. The same pain is felt with the return of consciousness after gas or ether unless the patient is under the influence of morphia. When pain seems likely to occur, the patient should be given a prescription for some palliative treatment, which differs according to the case. Ten grains of Empirin, or five grains each of aspirin and phenacetin, taken together, with half a glass of water, will in many cases help until the services of a dentist can be secured. Generally, however, drugs should not be taken except on professional advice, as some people react abnormally to them. Many patients do not realize that they should receive further treatment after the extraction of teeth and should visit the dentist until the wound has healed and all pain and discomfort have subsided.

Fear

Fear is an emotion, a state of the mind, but is associated with bodily sensations, especially pain. Closely related to fear are other emotions, such as dread, which is a diminutive, and fright, an intensified condition. Fear in animals induces fight, or flight. Man has learned to suppress these actions, and the effect of energies, generated but not actually transformed into activity, is still discernible but expressed as trembling, sweating, blanching, rapid respiration, and increased heart-beat. Dr. Crile, of Cleveland, Ohio, well known for his studies of surgical shock, compares these manifestations with the detrimental action of a motor running at full speed in an automobile that is kept stationary.

Fear exaggerates all of the bodily sensations. Timid persons alone in a house at night imagine all kinds of things if they hear the slightest sound, and in the same way fear gives rise to false ideas regarding the state of the body. It destroys the power of the mind to reflect and paralyzes judgment and reason. The person who, before an operation, has been told dreadful stories by some thoughtless friend is at least apprehensive if not actually frightened, and associations such as the

sound of surgical instruments, the sight of blood, the thought of a surgical operation, or the necessity of having a tooth extracted induce in many people extreme effects amounting to prostration. Even the use of the dental engine produces a feeling that cannot be described but is familiar to most of us.

Fear cannot be overcome by taking drugs. Its only antidotes are faith, confidence, and knowledge. If a person knows that his dentist uses the latest methods to eliminate suffering and has sufficient confidence in him, his fears will be decreased to a minimum. Instead of telling every one how he dreads having a certain dental operation performed, he should accept it as a matter of fact. The less he talks and thinks about it the better. When in the dentist's chair, he should not let himself fix his mind on the operation. Pain is much better borne when the mind is calm and relaxed. It is the constant nervous tension which causes fatigue and weariness rather than the suffering of actual pain.

Right Psychology Helps Children

Children should be brought up with a proper amount of self-control and taught the virtue of submitting heroically to a certain amount of

physical pain and punishment. Such training begins in the nursery and is achieved by suppressing too many expressions of sympathy for minor hurts and accidents. Wrong suggestions are often made carelessly or thoughtlessly and have an important influence on the child, ever alert to increase his knowledge of life. One should not discuss his own dental troubles when the children are about, and when one takes them to the dentist one must not instruct them to "be brave" and "not to be afraid," or assure them that "they will not be hurt." In the first place, it may be necessary for the dentist to do something that causes slight pain, and the confidence of a deceived child is not easy to regain. Secondly, just as soon as pain and fear are mentioned, a suggestion is made which fixes the mind of the child so that he can think of nothing else but pain and fear and becomes extremely suspicious. On the child's first visit to the dentist, it should be arranged that nothing be done but an examination and, perhaps a cleaning of the teeth. This gives the dentist a chance to make the acquaintance of his little patient and gain his confidence. The rest can be left to him. He has made a study of how to take care of children, and very often it is better if the mother does not stay with the child. Parents who

pay attention to these little details do their children a great act of kindness, besides making it easy for themselves and every one else concerned.

CHAPTER X

EXAMINATION OF THE MOUTH TO PREVENT SERIOUS DISEASE

“Knowledge is the foe of disease.”

The reader has learned from the previous chapters that dental diseases may start and progress unnoticed, since pain often gives its warning only when the opportunity for successful treatment has passed. Unsanitary conditions may exist in people's mouths without their being aware of the fact, and when the day of reckoning comes it may be necessary to lose one or even all the teeth, which, in addition to physical and esthetic disadvantages, may involve a large outlay of money for reconstructive work.

To get some idea of what is going on in his mouth, the reader should scrutinize his teeth carefully, standing in front of a well illuminated mirror. He should examine his child's teeth from time to time and observe the color of the gums, whether the teeth are clean and free from deposits, whether they are straight or crooked. Tooth-decay, however, cannot always be dis-

covered in this way, especially when the cavities are small.

Spots of chalky character indicate that the enamel has been softened, while dark discoloration may be due to certain filling material or medication (silver nitrate). If a tooth turns pink or dark after an injury it indicates bleeding inside the tooth, after which it becomes diseased. These conditions need immediate attention.

On account of the importance of attending to cavities when they are just beginning, it is necessary to go to a dentist at regular intervals for examination. This visit may be made the occasion for a cleaning of the teeth. One should form the habit of having his mouth carefully examined every five or six months. He should not put it off until he has a toothache, for then it may be too late to save the tooth.

The Value of the X-Ray

Unless it is evident that the teeth are perfectly healthy, that there are no large fillings, crowns, or bridges and no inflammation of the gums, one should have an X-ray examination of his teeth. The dentist, if he is painstaking, may find every cavity in the mouth by means of an ex-

plorer and discover any unhealthy place on the gums by careful inspection, but no matter how long one has gone to him nor how well he knows every tooth in one's mouth he has no means of finding out what is going on inside of the jaws and teeth except by the X-ray method.

The X-ray picture will show the conditions under the surface; it will show whether a tooth has a root-canal filling and whether this filling is perfect or not. It is the only means of disclosing infection at the root end of a tooth and pus pockets at its side. Leaky fillings, over-hanging gold crowns, and other imperfections can be discovered. To the expert dentist, who understands how to read the marks left by disease, treatment, and healing, a complete X-ray examination, combined with clinical inspection, will tell the whole past history besides the present condition of the mouth. If one has dead, or pulpless teeth, he should have them investigated by the X-ray method. He should not try to remember which of them have had the pulps removed. It is a mistake to have only a few of the teeth X-rayed. A careful diagnostician will insist on a systematic investigation, as it reflects on his judgment if anything is overlooked.

The Value of Periodical X-Ray examination

Because of the ease with which diseased conditions are overlooked, the writer has recently instituted an arrangement with some of his patients to have their teeth X-rayed every year, or at least every second year. The discovery of small cavities hidden under the gum, or just beginning under a filling or a bridge, fully justifies such a procedure and often prevents a great deal of trouble, suffering, and expense.

A man made an appointment with me some time ago for extraction of a loose and painful tooth. He had lost a great many of his back teeth, which had been replaced years before by bridges. After extracting his tooth I tried to impress upon him the importance of having the rest of his mouth X-rayed, to determine whether the teeth were all right under the crowns. He thought, however, that since he had had no pain or discomfort from these teeth it was not necessary. I advised him not to put it off too long. He returned two years later, sent back to me by a nose and throat specialist, whom he had consulted because of a discharge from the right side of his nose. It was found that the pus came from

the maxillary sinus, which had become infected by a tooth. X-rays of the teeth showed that the only molar on the right upper side had a large cavity under the crown, which had caused disease of the pulp, from which the infection had spread. When he found that the tooth, which anchored a long bridge, must be extracted and that the only replacement that could be used was a plate, he was indeed very sorry that he had not taken my advice.

Beware of Commercial X-Ray Laboratories

Can any one explain why some people should prefer to patronize commercial X-ray laboratories, operated by laymen, rather than dentists who have been properly trained in dental schools, or by graduate work and special studies, and who have been examined and licensed by the State to safeguard the people? Any one can be trained to take X-ray pictures, but to interpret them correctly it is necessary to have exact knowledge of the anatomy and pathology of the parts concerned. The man who makes a diagnosis of any value must be familiar with the problems of dentistry and must know how disease affects the radiability of the tissues. A man who works with the pick and shovel, although he may be an excellent excavator, would not be the one who would be asked for an

opinion about the value of a mine, and it seems just as illogical to consult an electrician, no matter how good a one he may be, about the teeth. In my books on oral roentgenology I have lamented the fact that there was no law prohibiting the most incompetent from taking X-ray pictures and furnishing elaborate reports. Since that time such a law has been passed in Pennsylvania, making it illegal for laymen to make and interpret X-ray pictures.

How an X-Ray Helps When One is Suffering

When one has a pain from some diseased condition in the mouth it is not always easy for the dentist to make a correct diagnosis at once. An X-ray investigation will, however, almost always give information which may help to differentiate between conditions causing the same symptoms. Many mistakes in treatment can be avoided by the use of the X-ray, saving the patient a great deal of trouble and expense. I can recall many cases in which the patient had indefinite swelling and pain about the jaws, which were treated for weeks or months by means of root-canal medication, until the patient finally became discouraged. When an X-ray examination was made it invariably revealed the trouble, which generally was

some diseased condition in the jaw that required more radical measures for a cure.

A patient, a boy sixteen years old, had observed a swelling under his upper lip for several months, two upper incisors being somewhat tender to touch. His dentist opened the root-canal of one of these teeth, removed the pulp, and treated the tooth. Whenever the root-canal dressing was removed, a yellowish fluid escaped. This treatment failed to help the condition, and the gum was lanced several times without result. When the boy was first brought to me for consultation an X-ray picture was taken, from which a diagnosis of cyst, containing an unerupted tooth, was made.

Another patient had a discharge of pus from a sinus on the gum over the right upper central incisor. The tooth had been extracted and a bridge had been made to replace it, but still the pus discharged from the socket. An X-ray picture revealed an infected cavity, partly connected with the socket of the extracted tooth, and the end of the adjoining lateral incisor root protruded into it. The discharge from the socket came from an infected cavity in the bone.

All this shows the reader how important it is



FIG. 28. TOOTH-BRUSHES FOR THE CLEANING OF BRIDGES

to have the condition of the teeth investigated. He should not wait until he has pain, or until his general health is undermined by pus absorption. "To-morrow is the enemy of health."

CHAPTER XI

MOUTH HYGIENE

“It is a clean tooth that never ached.”

Until certain errors in man's diet have been radically changed, and food is selected, manufactured, and prepared according to the needs of the body, instead of for the pleasure derived from its consumption, it will always be necessary to resort to artificial means to prevent the common diseases of the teeth from which civilized man suffers to-day.

In 1914 Dr. Alfred C. Fones, pioneer in oral hygiene work, established in the public schools of Bridgeport a system of mouth hygiene by means of which he was able to decrease dental disease to a large degree. He demonstrated that it was better to prevent the teeth from decaying than to establish repair clinics, the work of which would be endless. Dental hygienists were placed in the different schools, and their number was increased until in 1919 twenty-six were appointed. These women, who received intensive training, both scientific and practical, in a special school for dental

hygienists, have under their care the mouths of nearly twenty thousand children.

A firm believer that clean teeth will not decay, Dr. Fones began the first year with the first and second grades. A system consisting of four distinct parts was carefully worked out. First, the hygienist would clean the teeth of every child in the school. Secondly, tooth-brush drills were established to teach a method of mouth brushing at home. Thirdly, class-room talks concerning food and cleanliness were given and stereopticon pictures shown; and, fourthly, the parents' interest and coöperation were secured by means of special educational literature.

The Results of Dr. Fones's Work

The result of this work gives an excellent foundation for hopes of what may be accomplished by prophylactic treatment. In 1921 the reduction in dental decay in thirty schools where the children were under treatment averaged 69.3 per cent. Only sixty-five children out of 1161 in the fifth grades had any cavities in their permanent teeth. The reduction in decay was also accompanied by a reduction of the percentage of retarded pupils from an average of forty to twenty, which means a considerable saving to the taxpayer. This is

a great accomplishment when one considers the many difficulties which stood in the way of proper execution of the plan. Much depends on the willingness of the children and parents to do their part at home, and a great deal more could be done if the dietary factor could be controlled.

If such averages can be obtained in public schools, how much more can be accomplished at home! With proper mouth hygiene and prophylactic treatment, caries and pyorrhea can be reduced to a minimum. The best results are obtained by giving the teeth the right care every day, supplemented occasionally by a thorough treatment at the office of a dentist.

The Care of the Mouth at Home

The brushing of the mouth has a double purpose. First, it removes the soft deposits which gather around the gum margins, between the teeth, and in defective places, and, secondly, it increases the blood circulation in the gums and other oral tissues. Certain places, however, which cannot be reached with a tooth-brush, require the use of dental floss. A thorough rinsing of the mouth to remove all foreign material will complete the toilet of the mouth.

There are many satisfactory brushes made, but



FIGS. 29 TO 32. HOW TO BRUSH THE TEETH

See text

Courtesy of Dr. A. C. Fones, Bridgeport, Conn.

the type illustrated in Figure 29 is preferable. It should be remembered that tooth-brushes do not last forever. No one would be willing to use a broom to sweep the floor when it was in the condition of many a tooth-brush I have seen. When the brush is old and ragged, the gums are easily injured. For best results use a different tooth-brush on different days, alternating between two brushes, so that each will have a chance to dry after it is used. Fresh air and sunlight will keep them clean and in good condition and prevent rotting of the bristles.

Special tooth-brushes have been designed for cleaning bridges in the mouth. Those illustrated in Figure 28 are particularly well adapted to this purpose.

Many dentists believe that a powder is better suited to thoroughly cleaning the tooth surfaces than a paste. It should, however, be free from grit, so as not to injure the enamel of the tooth. The simplest preparation consists of the finest grade of English precipitated chalk, or this chalk mixed with powdered Castile soap (one half pound of chalk to one- and three-fourths pounds of soap). The other ingredients of the powders on the market are mostly flavoring-material. There are many pastes sold which are just as efficient as the

powders and more pleasant to use. Your dentist can advise you in this respect and recommend special dentifrices and washes for diseased gums or pyorrhea.

Dr. Fones's Instructions

By home care of the mouth it is possible to remove all of the food débris from the teeth if the following details are carefully observed:

First. The outside surfaces of the teeth and gums of both the upper and lower jaws.

Second. The inside surfaces of the lower teeth and gums.

Third. The inside surfaces of the upper teeth, the gums, and the roof of the mouth.

Fourth. The chewing surfaces of the teeth and the posterior ends of the arches, upper and lower.

A *light, rapid* stroke of the brush should be used at all times.

Place the tooth-brush inside the left cheek and on the upper gums, and nearly close the teeth together. Make the brush go backward and downward to the lower gums, then slightly forward and upward, until it has traveled a complete circle. This circular motion should be done rapidly, so that the gums will be stimulated and the teeth cleansed of food. Keep up this fast circular

motion and brush all the teeth on the left side, as well as all of the front teeth. Do not brush the teeth and gums crosswise (Figures 29 and 31).

Now brush the right side with the same circular motion, reversing the circle if found more convenient. Brush long enough to thoroughly stimulate the gums and cleanse the teeth, going back and forth over all the surfaces several times. (Figures 30 and 32).

With the bristles of the brush pointing upward and the end of the thumb on the back of the handle, brush the roof of the mouth and the inside gums and surfaces of the teeth with a fast in-and-out stroke, reaching back on the gums as far as you can go. Go back and forth across the roof of the mouth with this in-and-out stroke at least four times (Figures 32 and 34).

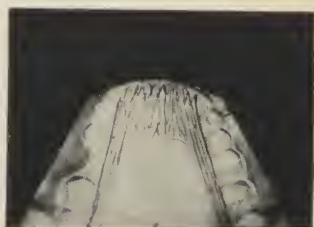
Hold the handle of the tooth-brush in the fist, with the thumb lying across the back of the handle, and brush the gums and teeth with an in-and-out stroke, using chiefly the tuft end of the brush. Reach back in the mouth on the gums below the last tooth on both sides and brush with a fast, light, in-and-out stroke. Tip the handle of the brush up in brushing the gums back of the lower front teeth, or use the tuft of the brush (Figures 33 and 36).

Lastly, brush the teeth with an in-and-out stroke on the chewing surfaces, as the food must be removed from the grooves or fissures of the molars.

The Use of Floss Silk

Four-fifths of the decay of teeth takes place on the surfaces between the teeth and on the chewing surfaces. There is but one way which is effective in removing the food from between the teeth, and that is with a piece of floss silk, preferably the wide kind. Use a section of floss about twelve inches long. Hold one end between the thumb and first finger of the left hand, and wrap the floss twice around the end of the first finger. Do the same with the thumb and first finger of the right hand. Now, by using combinations of the ends of the thumbs and second fingers, the floss may be carried into the mouth and forced carefully between all the teeth. Rub it back and forth against the surfaces of each tooth to loosen and remove the food and to clean these surfaces. After a little practice one can floss all the surfaces between the teeth in a moment (Figures 37-39).

People who wear fixed bridges should be supplied with the blunt curved needles called bodkins,



FIGS. 33 TO 36. HOW TO BRUSH THE TEETH

See text

Courtesy of Dr. A. C. Fones

by means of which floss silk can easily be carried underneath a bridge for the purpose of cleaning the part in contact with the gum.

Lime-Water

There still remains on the surfaces of the teeth, particularly between them, a glue-like deposit known as mucin. This mucin must be removed, as it allows the bacteria to cling to these surfaces. Dr. Fones recommends, as the most effective solvent, lime water, which is used as a mouth-wash and is harmless. In fact, if but one thing could be used to prevent decay of the teeth, lime-water used three times daily would prove to be the most valuable.

Secure from a paint-store five cents' worth of coarse unslacked lime and crush it into a fine powder. The refined lime that the druggists sell does not seem to have the same solvent action. Place a half-cupful of the powdered lime in a quart bottle and fill nearly full with cold water. Thoroughly shake and then allow the undissolved lime to settle at the bottom of the bottle, which will require several hours (Figure 40). After the lime has settled, pour down the sink as much of the clear water as can be poured without losing

any of the lime. This water is poured off because it contains the washing of the lime and is not pure enough to be used.

Again fill the bottle with cold water, shake well, and allow the solution to clear itself. After the lime has again collected at the bottom of the bottle, fill a twelve-ounce bottle with the clear solution of lime-water, being careful not to stir up the lime at the bottom. The twelve-ounce bottle is used as it is easier to handle at the wash-bowl. Refill the large bottle with cold water, shake well, and set it aside to use when the smaller bottle has been emptied. This process may be repeated until all the original half-cupful of lime has been completely dissolved.

After brushing and flossing the teeth, pour out a little of the lime-water into a glass and, taking it in the mouth, force it back and forth between the teeth with the tongue and cheeks until it foams. When it begins to foam, this shows that it has been in the mouth long enough to have had a beneficial action on the teeth. Now rinse out the mouth with clear water.

If the lime-water is a little strong at first, dilute it about half and half. It should be used full strength, however, just as soon as the gums have

become hard and healthy through the treatment by brushing method.

With the use of lime-water the toilet of the mouth is complete. The actual time required for the care of the teeth amounts to fourteen minutes daily. Faithfulness in mouth cleanliness will not only prevent dental disease but will prove to be a valuable insurance for health. No one can save a person's teeth but himself.

If the teeth are sensitive, if they are set on edge when acid fruits are eaten, such as grapes, lemons, or grape-fruit, use milk of magnesia as a mouth-wash. In children's mouths it will also prevent the green stain which comes on the teeth from an acid condition.

The Rules of Dr. Fones

1. Brush the teeth four times a day: Before breakfast with clear water, after each meal with a tooth-paste or powder. The teeth must be clean and free from food before going to bed, as most of the decay takes place during sleep.

2. Brush two minutes each time, two minutes by the clock. It takes two minutes of brushing properly to stimulate the gums and thoroughly cleanse the teeth. Be sure and brush the gums.

3. Do not use pressure with the brush. A fast, light stroke is best. A brush should never be worn out by having its bristles flattened and spread out. Do not brush the teeth crosswise.

4. Never allow any one to use your brush. Disease germs may be easily carried from one mouth to another, readily causing sickness.

5. Candies, sugar, crackers, cake, pastries, bread, will all decay the teeth if allowed to remain on their surfaces.

Prophylactic Treatment by the Dentist

The care of the teeth at home must be supplemented by regular visits to the dentist for prophylactic treatment. Very few people, no matter how conscientious, can keep their teeth entirely clean and free from tartar; and a great many, although they may make a great effort, will never accomplish anything like a satisfactory result.

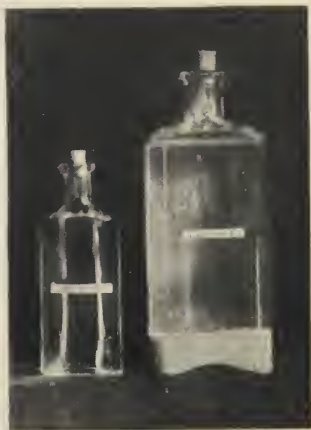
The dentist should decide how long the patient can keep his teeth free from deposits, and then tell him how often to report for prophylactic treatment. Some people require such service once a month; others can go two months, and others still longer. The prophylactic treatment consists of the removal of all deposits from exposed surfaces of the teeth and from under the



FIGS. 37 TO 40. THE USE OF
SILK FLOSS

See text

Courtesy of Dr. A. C. Fones



free margin of the gums, and of careful polishing of the teeth in order to remove stains, films, and bacterial plaques, which, as we have seen in the chapter on dental caries, all predispose to decay.

The Dental Hygienist

It was Dr. Fones who proved the great value of dental hygienists to help solve the problem of dental caries and pyorrhea through his energetic work with thousands of children in Bridgeport. We have far too few dentists to-day even to take care of the repair work, for which reason the busy practitioner often has no time for prophylactic work and preventive dentistry. It is, therefore, highly desirable to have trained assistants to help in this work, under the direction of a registered dentist. Training-schools have been established in several cities. Among these are the schools in Columbia University, at New York, the Forsyth Dental Infirmary, at Boston, the Rochester Dental Infirmary, in Rochester, New York, the University of Maine, the University of California, and Colorado College. Academic courses of not less than a year are given in these places. They consist of dental and medical subjects as well as practical training, and after graduation it is necessary to pass an examination held by the state

board of dental examiners. Dental hygienists are sometimes called dental nurses, which is not correct. They are in no sense nurses, because they do not care for "sick and infirm" teeth, but do exclusively work of a sanitary and preventive nature. In Massachusetts dental hygienists have been practising since 1917. The value of their services in private practice is undisputed, and for public health service there is a demand for dental hygienists which far exceeds the supply. Here is an excellent opening for young girls. Public dispensaries, public schools, Red Cross hospitals, industrial concerns, and department-stores all need dental hygienists to prevent dental diseases and to educate people in the benefits derived from such services.

Care of the Mouth during Illness

At no time is there a better chance for rapid decay and the beginning of diseases of the gums than during prolonged illness. The sick are generally fed on liquid or soft foods, which eliminate the self-cleansing action of mastication of hard and fibrous food; and brushing is often neglected or impossible. The result is that the gums become covered with a white film of dead gum tissue, which normally would be rubbed off, there

is a bad taste in the mouth, and an excellent chance for the growth of bacteria. The invalid's mouth should be cleansed with a piece of sterile gauze, moistened in a saturated solution of boric acid, and wrapped around the index-finger, or an orange-wood stick. The gums and all the surfaces of the teeth should be rubbed. If the patient is able to sit up, a tooth-brush can be used. A high temperature is usually accompanied by a coated tongue, which should be cleaned with a tongue scraper. As soon as the patient is well enough to go out, a prophylactic treatment should be given so that all the bacterial plaques which have formed can be removed before serious harm is done to the teeth.

There is nothing more disagreeable than to come in contact with a person whose breath is offensive. In unclean mouths the breath takes up the odor of decomposing food and gases formed from bacterial activity. The breath cannot be sweet unless the teeth are scrupulously clean and the tissues of the mouth healthy. Mouth hygiene is, therefore, an essential.

Dental Care for Expectant Mothers

Dental caries and acutely abscessed teeth are common occurrences during pregnancy. This

may be partly due to the additional requirements made upon the system, so that a latent infection can no longer be resisted, or to the lack of an adequate supply of mineral salts in the diet. Such a deficiency in diet may result in these salts being taken from the bones and teeth, predisposing the teeth to decay.

The expectant mother should have a careful examination, including X-rays, made of her teeth. If infected teeth are found they should be extracted, and the patient may rest assured that this treatment may be undertaken with perfect confidence. Cavities should be filled, but if a great deal of work is necessary temporary cement fillings should be used to stop the decay, leaving the permanent fillings for a later date.

That we may cease to be a race of dental cripples, all parents must be sufficiently impressed with the importance of the subject to make an earnest effort to protect their children from dental diseases by prophylactic measures, which should be begun as soon as the teeth appear in the baby's mouth.

CHAPTER XII

NUTRITION AND ITS RELATION TO THE FORMATION AND MAINTENANCE OF DENTAL STRUCTURES

“He who does not masticate well is the enemy of his own life.”

In an endeavor to understand the functions of our own body, in which each organ is made up of innumerable cells, highly specialized for their particular work, let us consider an animal which is merely a single cell, and yet capable of carrying on all the processes of living, just as effectually as the most complex organisms.

The Amœba

This tiny animal is the simplest form of life and is to be found on water-plants, or on dead leaves at the bottom of stagnant pools. It is called the amœba, and viewed under the microscope appears as an irregular mass of granular, jelly-like substance, which is called protoplasm. Careful observance will cause the student to realize that the mass is constantly changing its shape, by throwing forth projections (pseudo-

podia) of itself, into which the rest of the body protoplasm flows. This changing of shape is termed amœboid movement, and is the animal's method of locomotion. It is brought into operation by stimuli from various substances, which cause the animal to move, with seeming intelligence, in the direction of food, or away from harmful influences. The amœba takes food into its body at any point, by simply rolling over and encircling the desired substance. The waste products are discharged with equal simplicity, by being brought together in one contractile vacuole and thrust from the body at any convenient point. These are its simple means of eating and elimination. It also has the power of reproduction.

In considering this single-celled animal, which breathes, takes up food, discharges waste products, and reproduces,—in fact, performs all the activities of the more highly specialized animals,—we are brought to realize that all the processes of life reside, in some mysterious manner, in that living substance of which all cells are composed, the protoplasm.

Complex Organisms

It was the custom in earlier civilization for every man to perform all the duties incidental to

his personal welfare. He was his own gardener, blacksmith, carpenter, hunter, and so on, and each labor was executed with a rudeness which necessarily accompanies the untrained hand. Under modern civilization it is the system for groups of men to confine their energies to a particular work, and the product of that work is better adapted for use than that which is accomplished by individual effort. An analogy can be drawn on the one hand between the single-celled animal and the early worker, and on the other between the more modern banding together of men and the grouping of cells in the human body for the performance of more highly specialized functions.

Some of these groups of cells have developed by gradual evolution the power of contraction. They form the muscles of the body. Others have been changed so as to become suitable for the transmission of impressions to the brain, and these are the nerve-cells. Others produce bone and dental tissue. Because digestion is very complicated in man, it requires many groups of cells performing separate functions, and because all parts of the body depend upon the digestive system for their nourishment, it is necessary to have a simple but comprehensive idea of nutrition.

The Process of Digestion

Food is digested in the so-called alimentary canal, around which all animal forms are constructed. The human body, with its millions of cells, depends upon the flow of nourishment through the alimentary tract. The maintenance of the health, vigor, and youth of all material life depends primarily upon the right food and its proper digestion, prompt absorption of the nutriment, and quick and complete evacuation of the undigested residue from the intestines, to prevent absorption of poisons formed by bacterial decomposition of meat and other protein foods.

The digestive mechanism is put in readiness before the food is taken into the mouth. The pleasant sensations from the sight or smell of foods "make our mouth water," which means that the salivary glands are stimulated, with a consequent flow of their secretion into the mouth.

The function of the mouth is to prepare the food for digestion, which is facilitated in proportion to the amount of this preparation. Unfortunately, however, this important work, which should be thoroughly performed by the organs in

and intimately connected with the mouth, is generally neglected. A result of this is not only impaired digestion, but, as we have seen in previous chapters, underdeveloped jaws and many diseases of the teeth and surrounding tissues.

Mastication of Vital Importance

We sometimes read of the lost habit of chewing, when as a matter of fact the habit generally is not lost but is never acquired. Children, even when they have their first teeth, are still kept on a liquid, or semi-liquid diet which requires little or no mastication. The habit of bolting is formed, and it is not easily overcome. A dislike for hard food is acquired because the muscles of mastication have not developed sufficient strength to perform their natural vigorous function. The material should be pressed between the teeth and ground to a pulp by means of a lateral motion. To accomplish this it is necessary to possess a normal set of teeth. If a person has lost a number of his back teeth, his only accomplishment will be to punch a few holes into the food.

Besides crushing the food, mastication is also of great importance for a thorough mixing with

the saliva. I find that people do not realize this important factor, because patients often tell me, when I impress upon them the importance of replacing lost back teeth to restore masticating efficiency, that they get along quite well, as they eat hardly any meat. The idea seems to be prevalent that it is meat that requires the greatest amount of mastication, while actually the reverse is true. The saliva which is poured out of the glands into the mouth must be abundantly and thoroughly mixed with the starchy foods, such as potatoes, bread, and cereals, because they depend for proper digestion upon a ferment contained in the saliva called "ptyalin."

After suffering a long time from severe indigestion, a friend of mine had come to believe that he had some serious gastro-intestinal disorder. He had lost many of his back teeth and formed the habit of swallowing his food improperly masticated. His diet consisted, to a large extent, of carbohydrates, such as mashed potatoes and white bread. He did not realize that these foods, although soft, require mastication to mix them with the ferment contained in the saliva. His symptoms disappeared entirely when he had substitutes for the lost teeth made and learned to eat with them.

The Part the Stomach Plays in Digestion

The stomach is a large receptacle in which food may remain until it has undergone certain changes. Again, sensations start the flow of certain gastric secretions, and here it is the sense of taste that is the predominant one. When the food is in the stomach it is acted upon by weak hydrochloric acid, the ferment pepsin, which acts principally upon protein materials, such as meat. This chemical reaction is greatly aided by a mechanical function, the rolling motion of the stomach. These powerful muscular contractions bring all the particles of food into contact with the gastric juice. When we consider that the stomach is made up of soft tissue and lined with a delicate coat, containing the important secretory cells, it is easy to understand the warning that one should not expect the stomach to do the mechanical work of the teeth and perform the chemical action of the saliva.

When the food passes into the intestines it is acted upon by most powerful ferments secreted by the pancreas and the liver. The proteins, starches, sugars, and fats are now further reduced to simple compounds, such as can be absorbed and utilized by the body.

After the food is swallowed, the digestive process is involuntary and, assuming that the food is pure and wholesome, proceeds in a normal manner. Unpleasant feelings, however, such as vexation, worry, and anxiety, or great emotions such as anger, fear, and jealousy, will stop the flow of saliva, the gastric juices, and other important functions. The effect of the emotions on the body is a subject of great interest, and the reader who desires more information on this subject may be referred to Professor Cannon's book, "Bodily Changes in Pain, Hunger, Fear, and Rage." It is necessary, therefore, that the state of mind at meal-times be one of contentment and tranquillity and that the conversation be confined to pleasant topics, avoiding disagreements and quarrelsome arguments. The psychic secretion of the digestive glands is also promoted by serving the food in a dainty manner so that it is pleasing to the eye and savory to the nostrils, especially when, through illness, the appetite is fickle.

Assimilation and Evacuation

Assimilation or absorption of the nutrient fluids prepared by the process of digestion as described takes place along the walls of the intestinal tract. The greater part of the elements

to be used by the body is absorbed from the small intestine. When the part which is the undigested residue reaches the large intestine it is a semi-solid. By the time the content has reached the last part of the large intestine, most of the water and food elements have been absorbed from it, and it is ready to be evacuated.

Unless evacuation takes place promptly and completely, bacterial decomposition will take place. The reason for retarded evacuation may be an organic condition, or lack of training to encourage the habit of regular bowel movement at least once a day. Generally, however, the consequence of continued dietary mistakes is an important factor in chronic constipation. The use of too highly concentrated, purified, softened, and almost pre-digested foods is one of the greatest shortcomings of our diet. Milk, eggs, and sugar, white flour with the bran removed, and vegetables or fruit, with the cellulose destroyed by too much cooking, are examples. In such foods almost everything is absorbed, and there is not enough waste left to give sufficient bulk to the contents of the large intestine. Evacuation, therefore, takes place only after long intervals, and the residue clogs the walls of the intestinal tract. This long retention of the residue gives bacteria a chance to form

poisonous substances. Especially is this true if protein foods predominate.

Absorption of poisons formed in the large intestine is often the cause of serious injury to susceptible cells which make up parts or entire organs of the body. Symptoms of such a condition are undue fatigue, headaches, and a poor complexion. Their irritating effect on the tissues of the alimentary canal is often clearly expressed as a stubborn inflammation of the gums, a forerunner of pyorrhea alveolaris.

Metabolism

The nutrient fluid absorbed from the intestinal tract is carried by the blood-stream to all parts of the body and furnishes food for every cell, while the waste products of these cells are removed by the same carrier and finally disposed of by the function of special organs, such as the kidneys, the lungs, and the sweat-glands.

Protein, mineral salts, and water are the building-materials of the body, while carbohydrates, fats, and oils are essential to fuel or energy supply. Oxygen is also necessary and is supplied through the lungs, where it is taken up by the blood.

Long before the teeth come through the gum,

large bands of cell workers have been busy with their molding and construction. If a thin section is cut through the center of a tooth developing inside the jaw, it appears, when examined under a high-power microscopic lens, as shown in Figure 41. The so-called tooth-germ (A) is seen in a trench formed in the bone (B) and is covered by a thick layer of the gum (C). It is made up of two parts, an enamel organ and a dentine organ. The enamel organ (D) is composed of a large number of cells, from which highly specialized workers called ameloblasts have been developed. These are all lined up at the inner surface, like a battalion of engineers (E), while the remaining cells, left in the rear, aid in furnishing the necessary building-material. The dentine organ, which is contained in the bell-shaped enamel organ, also forms an army of builders, called odontoblasts (G), which are lined up opposite the ameloblasts. Blood-vessels are seen in the center of the dentine organ (I), their branches extending as far as the odontoblasts, which they supply with the material needed for building the dentine (H) or inner part of the tooth. Against this a layer of enamel is formed in similar fashion (F). It should be observed that the construction of these two parts of the

tooth occurs in opposite directions. The dentine workers proceed from the outside inward. They remain at the inner dentine wall, the pulp-chamber of the tooth, and, although they gradually become inactive, they are ever ready to take up again their duty of protecting the pulp, upon the vitality of which depends the health of the tooth. They do this by the formation of a well of secondary dentine, which blocks the way of the invading bacteria and fortifies the place which has been weakened by the formation of a cavity. The enamel workers proceed from the inside out, and disappear after the tooth has erupted. Enamel, therefore, cannot be renewed if part of it becomes destroyed after completion of the tooth.

The Quality of the Building-Material

While the soft enamel and dentine are laid down as a matrix, they are hardened by gradual deposit of calcium salts. A great deal depends upon an abundant supply and good quality of the material needed by these wonderful tooth workers. They must be furnished through the blood-stream with an abundance of mineral salts, and the supply must be kept up continually by selection of the proper food. A deficiency in mineral salts is the cause of soft teeth. If any

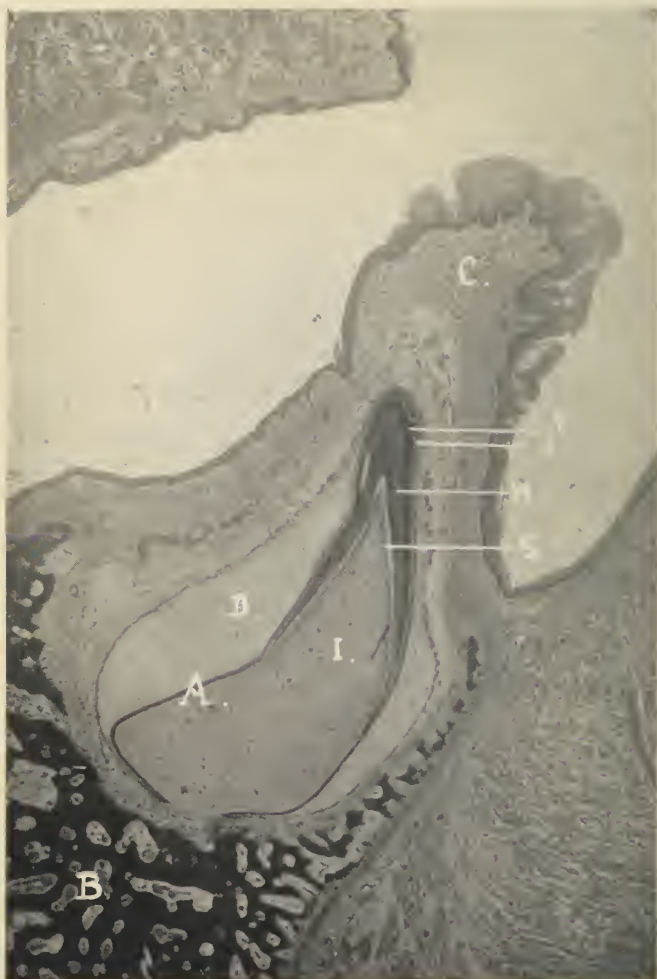


FIG. 41. PHOTOMICROGRAPH OF A THIN SECTION THROUGH A TOOTH DEVELOPING INSIDE THE JAW

A, tooth germ: B, bone; C, gum; D, enamel organ; E, ameloblastic cells; F, layer of enamel formed by ameloblasts; G, layer of odontoblastic cells; H, layer of dentine formed by odontoblasts; I, center of dentine organ with blood-vessels, later forming the pulp of the tooth

interruption in the calcification occurs, places which are only partly calcified will remain in the tooth. These are weak spots and cause the teeth on which they occur to decay very rapidly. The welfare and strength of the tooth constructors are also of great importance. If poisons circulate in the blood, taken up from some diseased condition in another part of the body, the workers suffer, their energy is lessened, and in some instances they may become so debilitated that work is stopped entirely. This leaves visible defects in the teeth and is a common result of scarlet fever, measles, or whooping-cough contracted during the period when the crowns of the permanent teeth were being formed (see Figure 42). To emphasize the importance of a sufficient supply of mineral salts during the time when the teeth are forming, it may be well to impress upon the reader that, unlike the soft tissues of the body, the enamel of the tooth, when once built, cannot be changed to any great extent, and, as the enamel has the function of withstanding mechanical wear and protecting the more porous and organic structures underneath, its hardness is of the greatest importance. The diet, therefore, must be selected with a view to supplying in sufficient quantity good building-material for the tooth.

The food which fulfils this demand is described in the chapter on diet.

After the tooth is fully formed, it still needs nourishment. This it receives through the blood-vessels of the dental pulp and the membrane surrounding its root. The dentine of the tooth, as well as the cementum covering the root, contains very fine canals, through which fluids may pass, distributing nutrient elements. It is important, therefore, to preserve the vitality of the tooth by preserving the dental pulp. A certain amount of increase in the calcification of the tooth is possible by these channels, and some investigators believe that an improvement is also possible in the case of the enamel, which, continually bathed in saliva, may take up calcium salts from this medium. It has been observed that people who are troubled with the formation of a great deal of hard deposit, or tartar, on their teeth generally have exceptionally hard enamel. Both conditions come from the saliva.

The old saying that every child costs its mother a tooth contains a great deal of truth. If the diet of the expectant mother does not contain enough organic mineral salts, the needs of her own body and that of the developing child are not supplied, and lime is extracted from her bones

and teeth to satisfy the demand. Lime is always needed by the body for various functions, but large amounts are required during the growing period of the child.

Supply of Mineral Salts for the First Teeth

It is the blood of the mother which furnishes the nutrition for the developing child. Although the teeth are not visible when the baby is born, and although the first tooth usually does not erupt until the child is six to eight months old, they nevertheless begin to calcify five months before birth, and at the time of birth the deciduous teeth are all present inside the young jaw. Their crowns are almost completely calcified. Even the first permanent molars are developing and have lime salts deposited in their cusps. When the child is six months old the enamel is completely formed on the entire first set of teeth. Proper calcification of the deciduous teeth, therefore, depends entirely upon the maternal nutrition. Calcium salts must be supplied by the mother's blood and later, when she nurses the baby, through her milk; therefore careful attention should be paid to her diet.

A case reported by the Department of Preventive Dentistry of the Royal College of Dental

Surgeons is an illustration of the far-reaching effects of improper diet on the teeth of a child. The mother's diet was confined entirely to bread, cakes, and jam, with from twelve to fifteen spoonfuls of sugar a day in tea or coffee. She consumed very little protein and could not masticate her food. The child was twelve months old, breast fed. It vomited after every feeding, and the teeth when they erupted were almost bare of enamel, which demonstrates the importance of proper diet for the expectant mother.

When the Permanent Teeth are Calcified

The permanent teeth calcify while the deciduous ones are in use. At the age of nine the crowns of all the teeth are finished, except that of the third molar, which takes about three years more (Figure 43). It is important, therefore, that the child should receive a diet rich in calcium salts and vitamins during this period of life. To some extent nature, ever economical, utilizes the mineral salts of the roots of the first teeth, which become absorbed as the permanent ones develop and get ready to take their places. Another important factor that must not be overlooked is the exercise of the mouth and muscles of the jaws when the child nurses at the breast. This ex-



FIG. 42. SPECIMEN SHOWING DEFECTS IN THE ENAMEL OF THE INCISORS

These defects are caused by interruption in the working of the cells producing the teeth, especially well shown in the upper central and lateral incisors, marked A, B, C. See text.

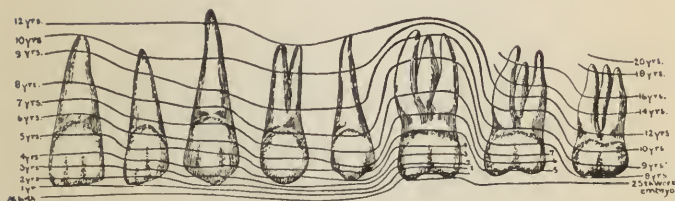


FIG. 43. PROGRESS OF CALCIFICATION OF PERMANENT TEETH

The lines show how far the teeth have developed within the jaw at given ages

ercise brings an ample flow of blood to the mouth, carrying with it the building-material for the deciduous teeth, and stimulating proper development of the jaws and face. After the child has teeth, the same result may be obtained by giving it hard food for the principal part of the meals, so that the jaws have to do natural, honest hard work, which the children enjoy if they have been rightly started. What to eat to afford the teeth exercise and supply all the ingredients of a diet favorable for the development of hard, healthy teeth and the maintenance of that condition will be taken up in the following chapter.

CHAPTER XIII

DIET AS APPLIED TO THE TEETH

“Gourmands dig their graves with their teeth.”

The bees have, for thousands of years, aroused the admiration and interest of man. They have been cultured since the time of the ancient Egyptians, and inscriptions on tombs show that they were highly revered. They have been cited by statesmen as having a model social system, with government by a single ruler, the queen. Poets, philosophers, and scientists, among whom may be mentioned Vergil, Aristotle, and Pliny of the Greek and Roman period and Réaumur and Maeterlinck of more recent times have eulogized the bees as unique among insects and have spent years of their lives in studying them. They have sung their praises and set forth their good qualities before mankind as an example worthy of emulation. One of the marvelous instances in the life of the bees is their method of feeding their young. There are three kinds of bees in a colony: the queen, the workers, and the drones. The drones are the males. The

queen is the true female of the hive. She is fully developed and resembles the worker except for her larger size. Capable of laying five thousand eggs a day, she can increase the number of workers and drones in her tribe enormously, but she jealously guards her sovereignty and permits no contemporary ruler in her domain. Under certain conditions, however, because of loss of the queen if she goes away with a swarm, or when old age comes upon her and her functions fail, or if she dies, a new queen must be reared. The workers, which are undeveloped females, make up the principal part of the population, do all the work in the hive, rear and nurse the young, and gather the nectar and pollen in the fields. The bees can raise a new queen at will from the same egg that might have become a worker by means of a special diet which is fed to the larva when it hatches from the egg. The larvæ of the working bees for three days are given a milky food prepared from honey and pollen, partly digested. Afterward they receive pollen and honey undigested until the sixth day, when their cell is sealed. If a queen bee is to be developed, the larva is fed on the very finest and most perfectly digested and concentrated food, called "royal jelly." She receives this during the entire period

of her larval state (five and a half days), and her cell, before it is closed, is half filled with the precious mixture. The discovery that the bees can produce from a female egg either a working bee of comparatively small size, or a queen bee, fully developed and larger, by different feeding, shows what an important part food plays in development of the young and what great results might be achieved if we should but study and apply the hidden truths of diet.

Knowledge to Improve Our Bodies

Very few people know what to eat; a large number eat too much, others eat too rich food, and a great percentage of people eat food which should not be used at all. Hardly any of us realize that certain shortcomings and weaknesses in the physical make-up of our race could be overcome by simple changes in the routine of our lives.

Food, air, water, sleep, and exercise are the physical essentials which develop a healthy body and keep it in good condition. A great amount of suffering is caused by disregarding the laws of nature governing the principles of these factors, and this applies especially to food. It is

said that Napoleon remarked that "an army moves on its stomach." Indeed, all the important activities in life that depend on health and energy are dependent upon proper nourishment of the body.

If the reader is sufficiently interested in the welfare of his body, he would do well to study his diet. Virtually all of us eat according to the desires of our palates, instead of the needs of our bodies and the requirements of our occupations. One should get some expert advice on the matter. It is better to consult a specialist when one is well, for an ounce of prevention is worth a pound of cure.

Food is classified into protein, carbohydrates, fats, and mineral salts and should contain in sufficient amounts certain substances called vitamins, which are absolutely necessary to good health.

Proteins

The proteins are nitrogen-containing substances which constitute the greater part of our bodies. Protein food is used to build and repair tissue and to replace the waste in the body cells. In times of great muscular exertion and when doing

heavy manual labor one requires a much greater amount of protein than when leading a sedentary life. It is supplied from both animal and vegetable foods (see table).

Fats

The fats are used to produce heat and energy and are stored in the body as reserve food, which is utilized in case of deficiency. A good example of storing fat is the hump of the camel. The hibernating animals, the woodchuck, bear, and others, exemplify the storing of fats at one season for use during another. Fats, or oils, are also found both in animal and vegetable foods (see table). If the diet contains too much fuel for the daily requirement one accumulates a store of fat and fastens on the body a useless burden, which interferes with the proper functioning of the body. It also incloses the body like the walls of a fireless cooker and prevents radiation of heat. This retention of heat in the body lowers the fuel requirement so much that no matter how little the fat person eats it is usually more than is needed and continually accumulates as fat. In winter and in cold climates more fats should be consumed for heating the body.

Carbohydrates

The carbohydrate foods, of which the principal ones are starch, cellulose, and sugar, yield heat and energy. Starch is one of the most important foods. It is transformed during the digestive process into sugar, which is absorbed and utilized by the body. It is contained in certain vegetables, but not in the leaves of vegetables, nor in fruit and animal foods.

Cellulose

Cellulose and woody fibers are not assimilated in the body. Although not classified among the principal food elements, they are nevertheless of great importance, helping digestion in a mechanical way and giving proper consistency to the contents of the bowels. They are found only in the vegetable world and in the husks of grains and are not contained at all in high-grade wheat flour.

Sugars

The principal sugar supply should come from the starchy food, which, as we have seen, is converted into sugar during the process of digestion.

The body makes its own sugar, and in addition obtains sugar from natural sources, such as sweet fruits, which supply levulose and grape-sugar. Commercial sugar is not only unnecessary for the well-being of the body, but, being refined, that is, deprived of its mineral salts, undermines the health and plays an important factor in the causation and predisposition to diseases of the teeth. The so-called craving for sugar is nothing but the desire to indulge in a habit that pleases the palate. For emergency food, sugar is the most easily absorbed of all. It is not a body-builder but merely supplies fuel and, taken between meals, destroys the appetite. Children who are allowed to eat sweets whenever they like show the effects, not only on their teeth, but on the entire development of the body. Whether the quality of the candy is good or bad does not matter; in fact, the very purity of sugar is its greatest fault.

If one insists on eating sugar, or if he has to sweeten his food to make it palatable, he should use natural sugar. The genuine brown sugar contains its original supply of mineral salts, and molasses often contains an excessive amount. Then, there are such sweets as maple-syrup and honey, "the drink of the gods." These natural



FIG. 44. These two rats, exactly the same size at weaning-time, were fed on rations of exactly the same character except that the one shown on the left in the picture was given 5 per cent of sunflower-seed oil, the other (on the right) was given $1\frac{1}{2}$ per cent of butter fat. Butter fat contains Vitamine A, which is not found in vegetable-oil. Observe the difference in growth

Courtesy of Dr. E. V. McCollum, of Johns Hopkins University

foods contain all their mineral salts and can be used in cooking to make the most delicious deserts.

Children who have never had sugar with their food, except as it is used in cooking, do not miss it. Their meals taste just as good to them. On no account should one tolerate the pitying remarks of friends who condole with "the poor child deprived of sweets." He is to be congratulated on having parents intelligent enough to insist upon adherence to a diet which will make him a robust man. No greater gift than health can be made to any child, and when this is the ideal the momentary pleasure that comes from indulging in candy sinks into insignificance.

Mineral Salts

Mineral salts are as important a part of our diet as protein food. Without either, life would be impossible. Bone, and especially teeth, require large amounts of mineral salts during their developmental stage, but mineral salts are continually used by the young, as well as the adult, for the performance of functions most important in maintaining life. The food, therefore, must contain such mineral matter as calcium, phosphorus, potassium, sodium, chlorine, and iron in

various combinations. During pregnancy and lactation there is an additional demand for mineral salts, and they must be abundantly supplied during these periods in the mother's life.

Popular Food Is Deficient

White bread, meat, and sugar, the most popular foods in America, are decidedly poor in calcium content. It would be impossible to eat enough of these to supply an adequate amount of lime salts to the body. Lack of mineral salts in the diet stunts the growth of the young. Without them, poisonous acids, which are formed as a result of fatigue, fail to become neutralized, and the user of such impoverished foods shows signs of chronic fatigue, nervous irritability, and depression.

"Give your friend a whole peach; peel it for your enemy." There is a great deal of truth in this old saying, because the mineral salts, so important for the reasons just described, are contained largely in the skins of fruits and in the outer coating of grains and vegetables. For this same reason, potatoes should be cooked without paring. To prevent loss of the soluble mineral salts when cooking vegetables, as little water as possible should be used, and in most instances the

water should afterward be used in making soups and sauces. Mineral matter is not evenly balanced in many foods. Some are rich in one and poor in another. Milk is very rich in calcium salts, while eggs contain an abundance of calcium, potassium phosphates, and iron. Meat is rich in potassium phosphates, but poor in calcium, while potatoes and other vegetables have a high potassium content. Refined sugars, white patent flours, and polished rice are deficient in mineral salts. The parent should see to it that the growing child eats plenty of food rich in these important substances, which are absolutely necessary for the formation of bones and teeth.

In the following table the more commonly used foods are classified under the heading of the nutritional element which is their chief constituent:

PROTEINS	FATS	CARBOHYDRATES			MINERAL SALTS
		<i>Starch</i>	<i>Cellulose</i>	<i>Sugar</i>	
Meats	Meat	Sago	Whole grains	Molasses	Milk
Fowl	Lard	Tapioca	Wheat	Maple-syrup	Eggs
Fish	Marrow	Corn flour	Oats	Honey	Meat
Eggs	Cream	Rice	Bran	Dates	Potatoes
Milk	Butter	Maize	Green vegetables	Figs	Fruits
Cheese	Eggs	Barley	Fresh fruits		Vegetables
Peas	Nuts	Oats			
Beans	Olives	Wheat			
Lentils	Cotton-seed	Potatoes			
Nuts	oil	Peas			
Grains, 10 per cent.		Beans			

Vitamines

Although no one has ever seen vitamins, they are most important constituents of our diet. Without them we cannot live and be well. The only way one can tell whether they are present or absent in a food is by feeding animals and observing the result. Certain diseases known as deficiency diseases are caused if one or more of them are missing.

A noted physiologist, Professor Hopkins of Cambridge, made experiments which proved that no animal can live on pure protein, fat, and carbohydrate food even when the necessary mineral salts are carefully supplied.

The vitamins, just as the mineral salts, are most abundant in the outer layer and the germ of grains and in vegetables and fruit. They are also contained in milk, eggs, butter, and meat. There are three groups of vitamins, the Fat-Soluble A, the Water-Soluble B, and the Water-Soluble C. The function of each of these is known and will be described.

Vitamine A

Vitamine A is called fat-soluble because it occurs in the animal food dissolved in fat. It is

fairly resistant to heat and is important to promote growth. The principal foods which supply it abundantly and which can be used as protective foods are cod-liver oil, the yolks of eggs, milk, butter, and most animal fats except lard.

Dr. E. V. McCollum, who has written an excellent book entitled, "The Newer Knowledge of Nutrition," experimented to show the influence of Vitamine A on the growth of rats (Figure 44). He took two rats, which at weaning-time were exactly alike. Both were fed on rations of exactly the same character, except that the one shown on the left in the picture was given 5 per cent. of sunflower-seed oil, while the other (on the right) was given $1\frac{1}{2}$ per cent. of butter-fat. Butter-fat contains Vitamine A, which is not found in vegetable oil. Observe the difference in growth.

Dr. Mellanby, an English scientist, found that puppies fed on food lacking this vitamine developed rickets within six weeks. Those that were given the same food with the addition of a little butter or cod-liver oil, did not have the disease. Rickets is a disease affecting also the human race and is characterized by impaired nutrition with an unusually low quantity of calcium salts in the bones.

Since this was written Dr. McCollum has stated

in a paper read before the Massachusetts Dental Society that his latest research work disclosed a fourth vitamine which is contained in abundance in cod-liver oil, also to a less degree in butter fats and to a far less degree in cocoanut oil. Vitamine A is absent in the last. By taking cod-liver oil and subjecting it to heat and oxidation he could destroy Vitamine A and experiment with the fourth vitamine. He found that this has to do with calcification and that calcium salts could not be utilized for the formation of teeth and bone unless it was supplied in sufficient quantity.

Vitamine B

Vitamine B is called the antineuritic vitamine, because the lack of it causes certain nerve disturbances. It is resistant to heat and, according to McCollum, is not destroyed in canned vegetables. The use of soda in cooking has a destructive action. It is found to some extent in all natural food, but is especially abundant in the seeds of plants, leafy vegetables, the germs of grains, and their peripheral layers, which are peeled off with the outer lining and form the bran. In whole wheat and rye flour, the bran is

not removed and contains this vitamine, while in white flour and polished rice it is lacking.

Eijkman, a Dutch physician, found that rice accidentally fed to his hens caused polyneuritis, a disease of which one of the symptoms is paralysis. The hens had been given cooked polished rice some days before the outbreak of the disease. Eijkman then made experiments and found that polished rice always produced polyneuritis in birds and that unpolished rice, or merely the addition of its outer coating, which is discarded in milling, immediately brought relief. Mendel made experiments with dogs and found that the lack of Vitamine B caused failure of appetite, decreased food consumption, and finally gave rise to polyneuritic symptoms, which would promptly disappear if extracts containing the Vitamine B were given.

Vitamine C

The Vitamine C, called the antiscorbutic vitamine because it cures the disease known as scurvy, is easily destroyed by heat, particularly heat of long duration. This is an important fact, when we consider that a good many people eat only cooked food and that generally it is the custom to cook food longer than necessary. By de-

veloping scurvy in guinea-pigs and then giving different foods for relief it can be determined which foods contain this antiscorbutic factor. In this way it was found that orange-juice and other fruit juices are protective foods. The Vitamine C, however, is also contained in vegetables, especially the leafy varieties, such as lettuce and cabbage.

Professor Theobald Smith was one of the first who demonstrated that scurvy could be produced in guinea-pigs by special diet, but Holst was the first to attribute the result to deficiency of the Vitamine C. The principal symptoms from a scorbutic diet are loss of weight, soreness of the joints, and characteristic changes in the jaws and teeth.

How the teeth are Affected

Dr. Percy Howe, of the Forsyth Dental Infirmary at Boston, has conducted interesting experiments to study the effects of vitamine-deficient foods on the condition of the teeth. He states that animals fed in this manner develop extensive dental defects. The teeth become elongated, irregular, and very loose. The gums become red and spongy, and extensive absorption of the supporting bone takes place. These conditions more

closely resemble pyorrhea than any such condition that has been previously artificially produced in animals.

The dental conditions which are produced by scurvy in man are illustrated by the suffering of the members of the crew of Stefansson, the Arctic explorer, who contracted scurvy in 1916. Besides general symptoms of weakness and dizziness, with a tendency toward laziness, depression, and irritability, they complained of loosening of the teeth and recession of the gums, with a dull ache in the gums and roots of the teeth. The teeth became so loose that they could easily be removed with the fingers, and the gums were of a cheesy consistency.

Vitamines That Come in Bottles

“Can you explain that curious twist in human nature,” writes the editor of the “Physical Culture” magazine, “that makes so many people buy their health in bottles?” Instead of correcting the dietary errors which cause constipation, they prefer to eat pills, and now, when the importance of vitamins has become more generally known, they try to buy vitamins in the drug-stores in pill-boxes and medicine-bottles.

It is very much better to eat fresh natural food,

in which vitamins are abundant, the so-called protective foods, which have been mentioned above. Milk, eggs, whole grains, and a liberal amount of fresh vegetables and fruit, according to the season, will furnish all the vitamins required by the body. Although canning and cooking do not destroy all the vitamins, it should be remembered that uncooked fruits and vegetables are to be preferred and should be eaten every day. These, besides containing vitamins, also contain an appreciable amount of mineral salts to build bones and teeth, and sufficient cellulose or fibrous material to prevent constipation, which so often results from the use of foods in concentrated form, and is so frequently the cause of sallow skin, headaches, pyorrhea, and nervous irritability.

Slightly Deficient Diet Dangerous

Dr. Clarence J. Grieves of Baltimore, who has made extensive experiments in this direction, found that serious results may occur, not only from diets entirely lacking one or more vitamins, but even when the vitamin content is only relatively defective, and that the disturbance from such diets appears to be out of all proportion to the cause.

A student in the Harvard Dental School wrote the following interesting facts in a thesis on the influence of diet on the development of the teeth: "My sister, one brother and I were all born and brought up in India, until I was eight years old, I being the youngest of the three. The food there was wholesome, and before our births my mother had this same kind of food. When I was eight years of age the family moved to Canada, where my youngest brother was born and brought up for six years. The food there was less wholesome and more fancy and sweet. My mother was always particular about the cleanliness of our teeth and mouths. Later my family returned to India, but alas! the damage was done. My little brother suffered from extensive decay and dental ailments, while the other three of us are free from any dental sufferings." This instance seems to indicate that diet plays an important part in preventive dentistry.

The following table compiled by the British Medical Research Committee to show the vitamine content of a variety of foods is taken from a book by Dr. Benjamin Harrow entitled, "Vitamines." The plus signs indicate the comparative abundance of the vitamins in the foods given:

<i>Classes of food-stuffs</i>	<i>Fat-Soluble A, or antirachitic factor</i>	<i>Water-Soluble B, or antineuritic (anti-beriberi) factor</i>	<i>Anti-scorbutic-factor</i>
Fats and oils			
Butter	+++	0	
Cream		0	
Cod-liver oil	+++	0	
Mutton fat	++		
Beef-fat or suet	++		
Peanut oil	+		
Lard	0		
Olive-oil	0		
Cotton-seed oil	0		
Cocoanut-oil	0		
Cocoa-butter	0		
Linseed-oil	0		
Fish-oil	++		
Hardened fats, animal or vegetable origin	0		
Margarine prepared from animal fat	Value in proportion to amount of animal fat contained		
Margarine from vegetable fats or lard		0	
Nut-butters		+	
Meat, fish, etc.			
Lean meat (beef, mutton, etc.)	+	+	+
Liver	++	++	+
Kidneys	++	+	
Heart	++	+	
Brain	+	++	
Sweetbreads	+	++	
Fish, white	0	very slight,	
Fish, fat, salmon, herring, etc.	++	if any	
		"	
Fish roe	+	++	
Tinned meats	?	very slight,	0

<i>Classes of food stuffs</i>	<i>Fat-Soluble A, or antirachitic factor</i>	<i>Water-Soluble B, or antineuritic (anti-beriberi) factor</i>	<i>Anti-scorbutic factor</i>
Milk, cheese, etc.			
Milk, cow's,			
whole, raw	++	+	+
" skim, raw	0	+	+
" dried, whole	less than ++	+	less than +
" whole, boiled	undetermined	+	"
" condensed			
sweetened	+	+	"
Cheese, whole			
milk	+		
" skim	0		
Eggs			
Fresh	++	+++	? 0
Dried	++	+++	? 0
Cereals, pulses, etc.			
Wheat, maize,			
rice, whole			
grain	+	+	0
Wheat, germ	++	+++	0
Bran	0	++	0
White wheaten			
flour, pure			
corn flour, polished rice, etc.	0	0	0
Custard powders, egg substitutes, prepared from cereal products	0	0	0
Linseed, millet	++	++	0
Pea flour, kilned		0	0
Soy beans, haricot beans	+	++	0
Germinated pulses or cereals	+	++	++

<i>Classes of food stuffs</i>	<i>Fat-Soluble A, or antirachitic factor</i>	<i>Water-Sol- uble B, or antineuri- tic (anti-beri- beri) factor</i>	<i>Anti-scor- butic factor</i>
Vegetables and fruits			
Cabbage, fresh	++	+	+++
" cooked		+	+
" dried	+	+	very slight
" canned			" "
Swede, raw, ex- pressed juice			+++
Lettuce	++	+	
Spinach, dried	++	+	
Carrots, fresh,			
raw,	+	+	+
" dried	very slight		
Beet-root, raw, expressed juice			less than +
Potatoes, raw	+	+	
" cooked			+
Beans, fresh, scarlet runner, raw			++
Onions, cooked			+ at least
Lemon-juice, fresh			+++
" " pre- served			++
Lime-juice, fresh			++
" " pre- served			very slight
Orange-juice, fresh			+++
Raspberries			++
Apples			+
Bananas	+	+	very slight,
Tomatoes, canned			— —
Nuts	+	++	
Miscellaneous			
Yeast, dried		+++	
" extract	?	+++	0
Meat extract	0	0	0
Malt extract		— in some specimens	

CHAPTER XIV

SUGGESTIONS FOR THE DIET OF YOUNG AND OLD

“Oh! that man should put an enemy into his mouth.”

Calcification of the teeth begins, as we have seen, five months before birth, and to insure strong jaws and sound teeth it is necessary that the mother's blood, which has to furnish all the material for the development of the child's body, should contain the necessary substances for the formation of the teeth. It is true that certain substances such as calcium salts and vitamins may be taken from the stores of her own body. This, however, can take place only to a limited extent and at a sacrifice of her own health. It is important, therefore, that the mother's diet should contain all the essentials for her own welfare and the normal development of the child. This means food rich in mineral salts and containing the vitamins necessary to the child's growth.

The one food best adapted for the first six to twelve months is the mother's milk, and there is

no artificial device which will furnish the same exercise to the baby's nose, mouth, and throat as nursing at the breast. The breast-fed baby must work hard for his food, and the parts which perform this work receive their benefit in an increased blood-stream and more abundant nourishment. It is evident that the quality of the mother's milk is influenced by her diet and that the supply of calcium salts and vitamins should be continued, as there is a great demand for these substances at this period of the child's life. If the mother's milk is poor, artificial feeding will bring very much better results, if carried out under the advice of a competent children's specialist.

It is generally agreed that the diet of the nursing mother should include a plentiful supply of milk and eggs and whatever vegetables and fruits are obtainable. In this connection it should be remembered that Vitamine C is only abundant in milk in spring and early summer, when the cows receive plenty of green foods. During the rest of the year the nursing mother must receive this vitamine from other foods (see table).

When the first teeth appear, that is, about the ninth month, there is a demand for something

more than liquid food. The baby should be given a little toast, or bread-crusts, which will also help the teething. If the child is weaned, a large part of his diet will still consist of cow's milk, modified and supplemented in one way or another; but it should be remembered that the Vitamine C is destroyed by heat, and if pasteurized or sterilized milk is used orange-juice must be given. When the baby is twelve months old, soft cooked eggs and spinach should be added to the bill of fare.

Between the ages of eighteen and twenty-four months, the child completes the first dentition and is now fully equipped to masticate his food properly, and mastication should be induced by giving him the proper food. Children very easily acquire a taste for soft food and refuse anything which requires special effort to chew, but if they are properly started they enjoy hard food. Soft fibrous food is, therefore, introduced, such as baked potato, baked apple, stewed prunes, green vegetables, peas, and carrots, as well as tender roast beef and lamb chops, finely ground.

The Period When the Permanent Teeth are Calcified

Although the first permanent molar begins to calcify before birth, the most important time for

the formation of the enamel of the permanent set of teeth as a whole is between the ages of two and ten. It should also be remembered that the enamel is formed from the inside out, and the enamel which is exposed to the influence of the mouth is the last to calcify. The illustration in Figure 43 gives an idea of the progress of calcification of the permanent teeth, according to age. It is important, therefore, that the child should receive, during the period of tooth formation, a large amount of the foods necessary to the formation of sound tooth tissues. This means foods rich in mineral salts and vitamins. The child is gradually given harder and harder food, for its beneficial effects on the growth of the jaws and nourishment of the teeth.

Milk, although not a natural food after the child is equipped with teeth to eat, is nevertheless a most desirable addition to the diet of the growing child, because it supplements whatever is deficient in the other foods. Its mineral contents are of great importance, as is also the fact that it supplies all three vitamins. One should remember, however, that the Vitamine C is only abundant in the milk of cows if they receive plenty of green food, and that in pasteurized,

sterilized, or cooked milk, these same vitamins are to a large extent destroyed. It is necessary, therefore, to use with such milk orange-juice or fresh vegetables, which are rich in Vitamine C. Milk should be taken preferably at the close of the meal and not as a fluid in which to soak bread, crackers, and other hard food, so as to render chewing unnecessary.

Bread is, next to milk, perhaps the most popular food. That which is made of white patent flour is generally the best liked. It is, however, deficient in vitamins and mineral salts and should be avoided if bread forms a large part of the diet. Whole wheat and rye bread and whole corn bread are recommended instead, as they contain all the ingredients of the cereal. If one cannot obtain genuine whole wheat flour, one can, for a few dollars, buy a small grinding machine and make his own flour. Many people do not realize that corn, like wheat, has an outer skin which contains the valuable substances for growth and maintenance of life, and that this is lost during the process of refining. Animals fed on such corn-meal will not grow; poultry fed on it exclusively will die within two months. Why should one give food made of deficient flour to his chil-

dren, and why should he eat it himself? What is true of flour is true of breakfast-foods prepared from cereals. One should be sure that the various preparations that he uses are made from the entire grain and that the vitamins are not destroyed in the process of refining. This pertains to all breakfast-foods, whether made of oats, wheat, buckwheat, rice, barley, or corn.

For Breakfast

When the child is two years old and can be trusted to use the teeth, hard breakfast food is to be preferred and should be gradually introduced. It should be given, without sugar, but with thin cream or milk. Use whole wheat meal or undegerminated corn-meal porridge, or scotch oat-meal (not the long, soft-cooked oat-meal pap), or any of the patented breakfast-foods, so long as they are made from the honest, whole grain. The addition of nuts, and of dried fruits such as dates and figs, is very beneficial, and makes the food so palatable that even children who are accustomed to eating their cereal with sugar will not miss it. The choice of fruit can after the age of four be enlarged to ripe raspberries, strawberries, blackberries, oranges, ripe cantaloupes,

stewed dates or figs, and raw or cooked apples with the skin.

Dried or toasted whole grain bread, or, for a change, some muffins made of the same flours, are given until the appetite is satisfied. Preserved fruits, honey, or pure maple-syrup in moderation may be given with bread. It is nourishing and at the same time tickles the child's palate. Milk is given according to age.

For Dinner

At noon soup made of beef-juice, lamb, or chicken broth, with two or three vegetables, or with thoroughly cooked, unpolished rice may be given. Soups made of stewed vegetables are also good. Meat or soft cooked (coddled) eggs, with plenty of fresh vegetables, potatoes steamed or baked and served in the skin (mashed potatoes are generally bolted), green peas, stewed carrots, beets, beans, or any of the leafy vegetables, and, in winter, dried peas and beans, unpolished rice, dried lentils, apple sauce, or any other fruit may be added. A slice of whole wheat bread with butter, a muffin, or a piece of toast may be added if necessary. Swedish bread, or oat cake, gives excellent exercise to the jaws and teeth. For dessert, uncooked fruit is the best, when the child

is more than four, and almost any kind that is entirely ripe will do, but be sure to serve it in the skin. Apples, dates, and figs can be used in winter when berries and other fruits are no longer available.

The Supper

The supper should be light; a breakfast-food such as has already been described, with milk and whole grain bread or toast, should be the foundation. An occasional change or an addition from the dinner menu may be made.

Between Meals

Children should be trained to eat a sufficient amount of food at meal-times and should not be allowed to eat between meals. The constant use of sweets is the cause of poor appetite and results in sickly, pale complexions and undernourished bodies. Sweet fruits, raw or cooked, should also be withheld until the hearty food is eaten. Water, however, should be freely given between meals. Many children have to be encouraged to drink water. During meals, however, only a little water should be allowed, and care must be taken that children do not use it to wash down their food.

The Food of the Adult

The food problem is a very perplexing one. A large number of our minor ills and a good many more serious ones are due to our criminal ways of eating. Proper eating is an important function, and what one should eat and why, is a knowledge every one should possess. Here we are only interested in the relation of diet to the teeth. What has been said in regard to choosing food to promote the development of strong, normal teeth in the child holds good for the maintenance of healthy teeth in the adult. Hard food will furnish the required exercise to keep the tissues surrounding the teeth in good condition.

Soft, soggy foods have a tendency to lodge between the teeth in places where they are irregular, and underneath inflamed gum margins and imperfect restorations, causing dental caries and pyorrhea alveolaris. Foods of this character should be avoided as much as possible. Under this group belong sugar, in its various forms, sweet biscuits, puddings, bread made from white flour, all new bread and that without a crust, bread soaked in milk, and preserved fruit. The cooking of certain foods, especially if overdone, also causes changes which make the food still

more adhesive. Stanley Colyer writes in "The Dental Record" that starch grains may be transformed into mucilage, and animal foods into soluble gelatine. These substances, he says, will not readily be removed by saliva, and its prolonged contact leads to damage to the dental tissues.

One should always use cleansing foods as much as possible. When this is not possible, he should at least see that the meal is ended with food of the cleansing kind. Dr. Sim Wallace, in a lecture at the London Hospital, gives the following foods as examples of the cleansing kinds: fibrous foods, such as fish, meat, bacon, poultry, fruit, pickles, savories, uncooked vegetables, lettuce, cress, radishes, and celery. Cooked vegetables, he says, are also cleansing, but in a less degree. He recommends using stale bread only with the crust, toasted bread, and twice baked bread. To this it should be added that our staple bread should be made of the entire wheat or other flour which has been milled without the removal of its outer layer. Such bread is coarser because it contains more fibrous material, and therefore its cleansing action on the teeth and its beneficial effect on the bowels occur. The fresh fruits make ideal dishes to end a meal. Those requiring mastication are to be preferred, such as apples, pears, and berries.

Rules for Eating

One should form the habit of eating properly. The following short rules may be found helpful:

When you sit down to your meal, be at peace with yourself and all who are with you.

See that you have plenty of time and do not feel hurried.

Eat hard foods, masticate them well, and get all the taste you can out of them. Do not soak your food in milk, nor lubricate it with butter, nor wash it down with water. Nature provides us with saliva for this purpose.

Food should be of the right temperature. We drink and eat many things that are too hot. The child will refuse food that is too hot, and, if he is forced to take it, it will hurt the delicate membranes and cause suffering.

The evils of over-eating become evident in adult life. Be moderate in your eating and stop when your appetite says, "Enough!"

Finish your meal with cleansing food, especially when you will not have an opportunity to brush your teeth at once.

Eat no food except at regular meal-times, but drink plenty of water, especially in summer.

CHAPTER XV

A PLEA FOR THE FUTURE

“Help develop sound teeth in the coming generation.”

To be happy it is necessary to be physically fit, and the readers of this book must now realize that nothing contributes more to the development and maintenance of health than right living and especially right eating. Clean and healthy mouths are only found in people in good physical condition. It is the healthy, happy, rosy-cheeked child who possesses beautiful and useful teeth. A mouth full of decayed teeth, harboring millions of bacteria, exposed pulps which cause pain every time hard food is crushed, and sinuses discharging pus which mixes with the food, cannot possibly be associated with good health, and causes, as we have seen, a great deal of suffering.

The reader has observed that a mouth full of neglected teeth predisposes to indigestion and that poisons draining into the system from unsuspected abscessed teeth may sap the strength and vitality of the body and prevent the attainment of a full share of success, whatever it may be, business,

social, or personal. With such handicaps one may look forward to years of infirmity and a burdensome old age.

If the reader realizes the importance of being well, he should have teeth X-rayed, his mouth put into healthy condition, and lost teeth replaced by substitutes, so that he can masticate his food properly. This will improve the digestion and the general health.

If he has become a dental cripple through neglect, either from carelessness or lack of knowledge, faulty diet or lack of hygiene, it is his duty to protect his child from the same mistake. Every child has the right to be protected from preventable diseases and to be started off in life with a healthy body and sound teeth.

How this can be accomplished is now clear to readers of this book, and the time is not far distant when so important a topic will become a feature in the education of every child. The application of such knowledge will greatly reduce the prevalence of dental diseases, and the writer will be more than content if this book succeeds in conveying the message of how to develop sound teeth in the coming generation.

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